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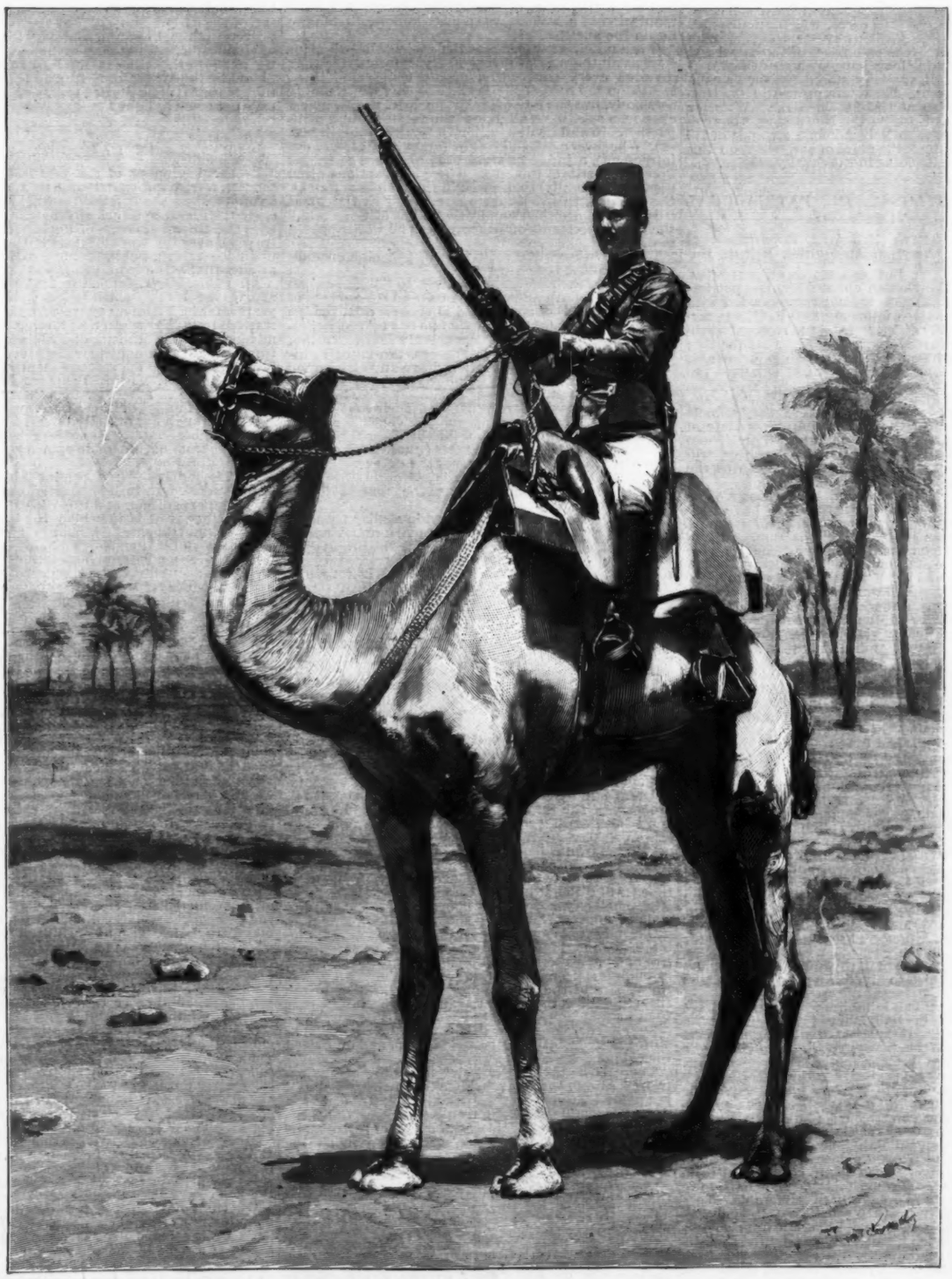
THE EGYPTIAN ARMY AND THE NILE CAMPAIGN.

IT would seem as though the Egyptian army were going to count for something in the present campaign against the Dervishes.

Late dispatches from Upper Egypt show that in the preliminary skirmishes the native army has displayed fighting qualities which must have been a surprise to its old enemy, the Mahdist. It has had several brushes with the Dervishes, in all of which it has not only made a resolute stand, but has repulsed them with considerable loss.

Contrary to all expectation, the Dervish attack has been made, not upon the Nile expedition, but at Suakin, on the Red Sea. Nothing could have been more fortunate for the Egyptians, for this diversion has left the road open from Wady Halfa to Akasheh, and the invading army has made the advance across this difficult stretch of country without molestation. The advance was materially assisted by the military railway which was built in the campaign of 1884, from Wady Halfa to Akasheh. The southern seventy miles had been destroyed by the Mahdists; but the first thirty-five miles, to Sarras, were still available.

The invading army is stated to have consisted of the eleventh, twelfth and thirteenth battalions, one squadron of cavalry, and the camel corps of the native army, including about 3,000 men, 120 horses, and 700 camels. The advance was made through a barren desert, and under a scorching sun, in three days, and after a preliminary cavalry skirmish, in which the Mahdists were driven off, the Egyptians occupied



THE EGYPTIAN ARMY—A SERGEANT OF THE CAMEL CORPS.

Akasheh. Meanwhile the Mahdists were being beaten by the contingent of the native army stationed at Suakin. The Egyptian forces marched out from garrison to the assistance of some friendly Arabs and defeated the Dervishes, and, effecting a junction with a Soudanese battalion under Major Sidney, who had already repulsed a fierce attack by the enemy, the combined forces returned in triumph to Suakin. The unlooked-for steadiness and courage of the Egyptians has had a marked effect upon their old time enemy, who had been accustomed to see the Egyptian army (rabble it should better have been called) scatter at his very first charge; and it is said that a retreat into the interior has been ordered.

It was natural that this present advance of the native troops should be regarded with anxiety by the friends of Egypt, for the previous campaigns of this kind had been marked by repeated disaster. They had not forgotten the fearful massacre of the native army under Hicks in 1883 and the annihilation of another native force under Valentine Baker, when 2,300 out of 3,700 men were slaughtered and 11 of the European officers perished. No doubt the failure of these expeditions was largely due to want of proper organization, as the recent successes at Akasheh and Suakin would seem to indicate; but it yet remains to be seen whether the fine organization and equipment of the present troops will enable them to withstand those famous rushes of massed bodies of the Dervishes which so nearly proved fatal to the picked British soldiers in 1883-84. In those days the chief weapon of the enemy was the spear, but to-day they are said to be fully supplied with rifles, many of them of modern construction.

We present an illustration, for which we are indebted to the Graphic, showing a sergeant of the camel corps of the Egyptian army. The corps, which numbers 500 men, was raised by Capt. Tudway for the service of the Khedive in 1893. The endurance of the camel and its capacity for making long journeys across the waterless desert render it specially suited for such a campaign as the present. This was proved in the Gordon relief expedition of 1883-84, when Lord Wolseley divided his force at Korti on the Nile and sent one column across the desert to Mebemmeh, a distance of 185 miles. The camel took the place of the horse on this march and proved its value in the cavalry service.

LIFE IN BABYLONIA IN PATRIARCHAL TIMES.

By THEO. G. PINCHES, M.R.A.S., Department of Egyptian and Assyrian Antiquities, British Museum, in Knowledge.

ACCORDING to Babylonian chronology, the patriarchal age in Palestine seems to have corresponded with the period immediately following 2200 B. C., the earlier portion probably differing from the received chronology by two or three hundred years. This question of chronology is a difficult one, and, though important, does not really belong to the scope of the present paper. Those who wish to go into the question of dates may consult the works of Sayce, Oppert, Schrader, etc., though, to say the truth, a really satisfactory scheme of chronology must, in the present imperfect state of our knowledge, necessarily be a matter of time. Those who read the present paper to the end, however, will see why the date of 2200 B. C. has been chosen as the earlier limit of the period treated of.

The age of the patriarchs in Palestine appears, from the account that has come down to us, to have been one of great simplicity of manners and customs and of an exceedingly primitive state of civilization. All civilization was then (compared with the present day) exceedingly primitive and simple, but it must not be imagined that the standard of the Hebrew patriarchs is to be that for the civilized world at that age. As early as 3800 B. C. the cuneiform writing in use in Babylonia had not only lost for the most part the hieroglyphic form which it originally had, but had also become highly artificial; and certain arts, notably that of engraving on hard stone, had made considerable advances. For sixteen hundred years after that time civilization had been marching with slow and measured pace (for everything goes slowly in the East), struggling in the trammels of superstition and against the retarding incursions of barbarous hordes, disadvantages with which it had to contend until the world was well within the present enlightened era.

Whether, when Abram, the father of many of the Semitic tribes, was in the district or city known as Ur of the Chaldees, he was living in a town or in the country is uncertain. The general opinion among scholars at present is that Ur is to be identified with the ancient city of Uri or Uriwa, now represented by the mounds known as Mugheir (Mukeyyer), in Southern Babylonia. This may be so, but it seems to be more likely that Ur of the Chaldees (Ur-Kasdim) is simply the Akkadian name of the district (not the city) known as Akkad, which, in the language there spoken, was called Uri. Abram, with his flocks and herds, would probably have preferred to live out in the country rather than in (or even so near as to be called "in") a city. The cities of Babylonia, however, must have been well known to him during the time that he lived there.

Small reason would an inhabitant of the plains have to love the cities of Babylonia—just as little as he would love the cities of the East to-day. The streets were narrow and the houses small. The walls were mostly of unbaked brick, sometimes plastered over, and the fireplaces were primitive in the extreme. The drainage, it is needless to say, was unsanitary. The builders of the houses knew, nevertheless, the importance of keeping the walls free from humidity, for they constructed drains and ventilators in them for that purpose. Life in an old Babylonian town, even with all the comforts of a royal palace of the time, would have fallen far short of what we are accustomed to in most of the houses of Europe to-day. Life outside in a tent would certainly have been preferable. To a monotheist, also, the heathen practices of the polytheistic Babylonians must have been far from sympathetic, however much he might have admired their intelligence, their philosophy, their civilization, their love of justice and their kindheartedness, which was, to all appearance, often thoroughly disinterested.

In judging the character of the people of that time, with their manners and customs, and their morals, so different from ours, we are bound to take into consideration the influence of their surroundings. For them and their contemporaries there was nothing wrong in polygamy and the possession of concubines, and slaves were chattels to do as one liked with; and it is in consideration of these customs that we must look upon the possession of two wives, as the following, from a tablet in the British Museum, shows:

TABLET RECORDING THE MARRIAGE OF TWO SISTERS TO ONE HUSBAND.

"Arad-Samas, son of Ili-ennam, has taken Iltani, sister of Taram-Sagila, from Samas-tatum,* their father, as his wife. Iltani is his consort. He will provide for her, he will care for her, he will carry her seat to the temple of Merodach. The children, as many as have been born, and as they will bear, are their children (i. e., the children of Iltani and her sister). If she (Taram-Sagila) say to Iltani, her sister, 'Thou art not my sister,' then . . . .† [if Iltani] say [to Arad-Samas] 'Thou [art not my husband],' then he may set a mark on her and sell her for silver; and if Arad-Samas say to his wife, 'Thou art not my wife,' then he shall pay her one maneh of silver.‡ And they (two), if they say to Arad-Samas, their husband, 'Thou art not our husband,' then (the people may) strangle (?) them, and throw them into the river."§

The names of the witnesses close the inscription.

When two sisters were wedded to the same man, each had a tablet very similar in wording to the above, but with the position of their names changed. Such a tablet was, in fact, a woman's marriage certificate, and testified to her respectability. In all probability she had but little chance of remarriage without it, for the reputation of a woman was a most important thing to her in the ancient East.

It is a noteworthy fact that the ancient Babylonians were at all times great lovers of legal forms, for they invested every transaction of life that could be so treated in the robe of the law. Not only the wedding ceremony, but the hire of a slave, a loan, a gift, an exchange, a sale, were all upon the same footing with partnership and its dissolution, adoption, inheritance, etc. Whenever a difficulty arose (and disputes were not infrequent), a judge was taken to pronounce a decision upon the merits of the case. These legal actions often (perhaps generally) took place in the temple of Samas, the sun god, this deity being regarded as the great "decider of decisions" and "the judge of the world," the pronouncements of whose judges he was supposed to direct.

The following will give an idea of the circumstance attending a deed of gift:

"Lamasu, their mother, has given to Sili-Samas one slave (named) Ana-Samas-kalama and 10 shekels of silver; 10 shekels of silver, and 10 shekels of silver (as) the wedding gift (of the wife that he has taken), to Sin-mubalit, his brother; and 15 shekels of silver to Taribu, his brother. Never shall Sili Samas, Sin-mubalit, his brother, and Taribu, his brother, have any claim upon what Lamasu, her son Apil ili, her son Amat-Rammani, and Mad-Rammani, her daughter, have and will possess. She has written (this) with their consent. At no time shall they make any claim. They have sworn by Sin, Samas, and Khammurabi the King."

The names of several witnesses (whose seals are impressed) follow, after which comes the date:

"Month Adar, of the year Khammurabi the King renewed for Istar and Nanaa the temple E-tur-kalama."

The sale of a house was couched in similar terms:

"One sar (of land), a house on a platform (?), beside the house of Sili-Nanaa, (and) beside the property of the sons of Ubar-Sin, (one) end the street, and (the other) end the house of Sin-azu. From Minanu son of Migrat-Sin, and Ili-turam his son, Sili-Nanaa son of Ili——*, and Apil-ili his brother, have bought it for 3½ shekels of silver, its complete price. At no future time shall they litigate against each other (concerning the house). They have invoked the name of the King."

Here follow the names of nine witnesses.

"His seal and the seals of the witnesses have been impressed. Month Sebat, day 26th, year of Rim-Sin, when the enemy who was wicked (smote (?) the lands)."

That slavery was in full swing may be gathered from the above texts (see the deed of gift), and sales of slaves similar to the following were therefore very common:

"Two hundred and four and two-thirds ka of oil, property of the Sun-god, value one-third of a mana, and two-thirds of a shekel of silver, as price of the fair (-skinned) slaves of the land of Guti, Arad-Marduk son of Ibni-Marduk has received by the authority of Amel-Mirra son of Ili-nsati, from Ubala-abi-ume. He will bring the fair (-skinned) slaves of Guti in a month's time. If he do not bring them in a month, then Arad-Mirra shall pay, according to his contract, one-third of a mana and two-thirds of a shekel of silver."‖

One might go on, however, indefinitely quoting interesting and important texts referring to this primitive and yet elaborated civilization of those early times. Enough has been given, however, to show what was the nature of the society and the civilization of the time; and it has this great advantage, that it all comes to us at first hand, from the people themselves. The texts are the same now (when they are complete) as on the day when the scribe wrote them, and impressed the cylinder seals of the witnesses.

There is a noteworthy point in the life of the patriarch Abram that may here be touched upon, and it is a point that must have struck many in former days. Abram, a simple shepherd, owning his own flocks, sets out from Ur of the Chaldees, and not only traverses Western Asia, but even visits Egypt; and in all the narrative there is not a word referring to any difficulty that he may have had in making himself understood.*

In Babylonia in ancient times it would seem that many languages or dialects were spoken, and these tongues the tradesman or farmer probably knew from his youth up. One of them Babylonian (generally called Assyrian), he would speak as his mother tongue, and of Sumerian and its dialect (Akkadian) he would know at least a smattering. From the Aramaic tribes in the country he would naturally be able to get a knowledge of Aramaic, and from the Amorites who were in Babylonia (there was an Amorite district in or near Sippara, now Abu-habbah, in about 2080 B. C.) he could obtain knowledge of the language spoken in Southern Palestine and elsewhere—a tongue, in all probability, closely akin to Hebrew.

For a journey to Egypt the above would be most likely all that was needed by him to communicate with the natives, for the Egyptian Pharaoh was, it is supposed, of Semitic origin, and he and many of his people must have understood the language of Western Asia. Any further aid that the traveler might require, however, he would find ready to his hand in the language now known as Assyrian (really Babylonian), which, as it was the lingua franca of 1,500 B. C., must have held the same position in Abram's time; and the traveler could, in all probability, have traversed the whole distance from Babylonia to Egypt (over a thousand miles as the patriarch must have gone), communicating with the inhabitants of the countries he passed through by this means alone. A traveler's linguistic equipment in those days was complete if he possessed some knowledge of Aramaic and Amorite as well.

Recent researches have, indeed, removed not a few hindrances to our perfect knowledge and understanding of the early history of that East which is so full of poetry and romance, and so important for the history of civilization. What may we not find when more of the many buried cities of the East shall have been explored by the excavator? Among the many thousand tablets that still lie buried there, who can say what may not come to light?

TRAVELS IN CAMBODIA AND JAVA.

IN the beginning of the year 1885, Mr. Albert Tissandier, a frequent contributor to La Nature, decided to undertake some extended voyages in order to observe the grand spectacles of nature in remote countries and the monuments of ancient civilizations. He traveled over the United States in the first place, and upon his return, published, in La Nature, a series of articles that attracted much attention.

After this, Mr. Tissander, in 1887, undertook a voyage to the Indies, which lasted eight months. Two years later he began a voyage around the world, and started from Paris after obtaining an archæological mission from the Minister of Public Instruction. Our traveler went to Pondicherry, whence he passed over into the Indies and visited Calcutta, Benares, Agra, Delhi, Kashmir, Ulwur, Bombay, Bijapoor, Ceylon and Singapore. After this he went to Shanghai and Pekin, and finally finished his voyage by extensive travels through Japan. He brought home documents of the highest interest, and especially two hundred drawings from nature made upon a voyage of eighteen months' duration.

Mr. Tissandier did not confine himself to this tour of the world, but, in 1893, started off again upon an exploring expedition, and this time devoted his attention to three regions in which the beauties of nature and the monuments of human art of ancient time may be counted among the finest curiosities of the world. He made new expeditions and numerous drawings as well as plans, especially at Cambodia where the Khmer ruins are situated, and where the tourist may also admire some marvels of ancient structures. Mr. Tissandier again had a mission from the Minister of Public Instruction. Upon his return from this voyage, which he completed by a sojourn in Australia, he devoted many months in Paris to finishing the drawings and plans that he had made. Of all these documents, it was his aim to make a new book which he finally did; and this he has now published under the title of "Cambodia and Java." We are going to make it known to our readers.

We shall not give a bibliographic notice here, but shall reproduce some of the curiosities visited, with the text that explains them.

We shall first mention the ruins of Angkor-Vat, which are reckoned among the most curious. In addition to the large structures, they comprise three pavilions, each surmounted with a dome and connected by porticoes. The entrances thus grouped are called, according to the bonzes, Cuc-moharéach, or "royal grottoes." The window frames and the cleres of the door frames are covered from top to bottom with ornaments having, as at Banh-Yong, the aspect of embroidered stuff stretched over the walls. And the foliage, "I remarked, in addition to fantastic animals," says Mr. Tissandier, "some interesting little motifs representing Khmer warriors in different costumes. One of them has just shot his arrow after having bent his bow. Another carries a club. Here is a Khmer soldier in a fighting posture, and holding a saber raised in order to strike his enemy. Another is defending himself with his shield as he fights. Some seemed to me more curious still. Those that held a club and ax had the head covered with a mask resembling a demon's face or an animal of fantastic aspect (Fig. 1). The Khmer warriors doubtless dressed themselves out in this way in order to frighten their enemies, after the manner of the Chinese, who formerly conceived the most frightful scarecrows and masks. The Japanese, also, as long ago as the sixth century of our era, at the time of the advent of Buddhism in their country, adopted masks for their religious dances and theatrical representations. In this they perhaps took example from the Chinese and the Khmers."

We shall now give a few details concerning the manufacture of a fabric designated in the island of Java by the name of "sarrong." Fig. 3 shows the aspect of a room in one of the manufactories devoted

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* Or Samasatum.

† Apparently one or the other was an adopted daughter of Samas-tatum, as, logically, a real relationship, such as that of sister, cannot be changed by the utterance of any formula.

‡ This was the act of divorce, the penalty for which, in the case of a man, was a money payment only.

§ See Meissner, "Beitrage zum alt-babylonischen Privatrecht," No. 60. He quotes also a tablet (92) in the Berlin Museum which is very remarkable for its form: "Akka-nusa has given Napirtum to a husband; no one shall part her asunder. One shekel of silver is her dowry. He who slanders her has committed sin. No one shall part her asunder."

‖ Meissner, Beitrage, No. 4.

* Apparently, also, he was never molested by lawless tribes—a condition of security which could not be claimed for this part of the world.

to the designers, who are seen making compositions upon the fabric with a pencil.

"The workman begins by spreading in front of him the fabric that he wishes to decorate. This is generally a sort of calico of European origin, the quality of which varies according to the future price of the material. He first traces upon the fabric, in light lines, the design that is to form the ornament of the sarrong. This operation finished, it is a question of covering the whole drawing with a thin layer of melted wax. To this effect he uses a special but very simple device. This apparatus, which is of copper, is a small reservoir about an inch in length, the bottom of which is provided with a light tube bent at its extremity. Sometimes, in order to make thicker outlines, the reservoir is provided with two tubes, one above the other. The extremity opposite the small tubes serves to fix the instrument in a bamboo handle. The boiling wax fills the reservoir, and, flowing out drop by drop, exactly covers the entire design.

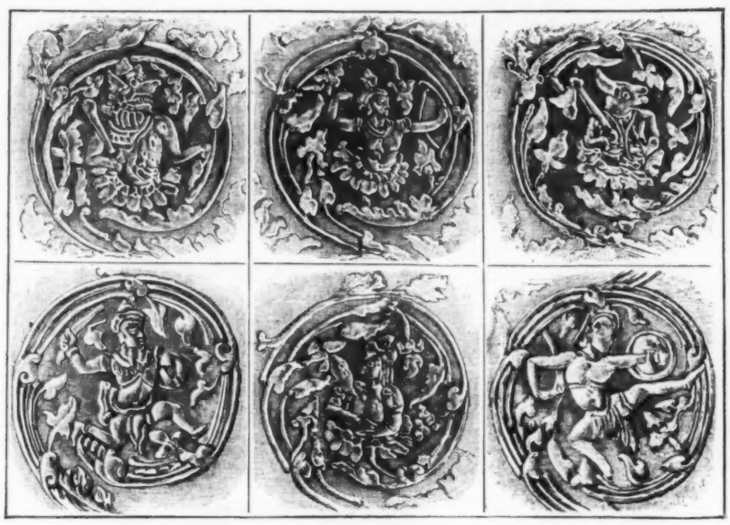


FIG. 1.—KHMER WARRIORS IN SCULPTURED STONE.
(Fragment from the clear of the door frames of Angkor-Vat.)

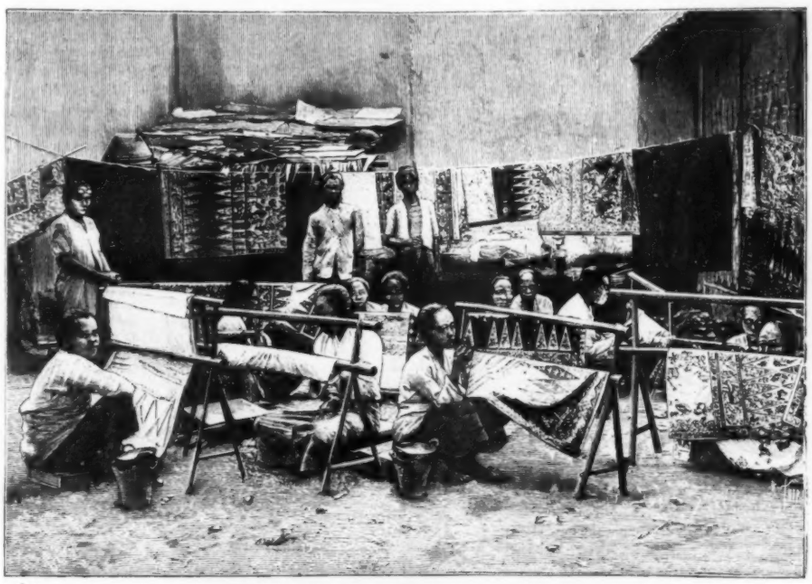


FIG. 3.—INTERIOR OF DESIGNERS' STUDIO AT BATAVIA.

FIG. 4.—VIEW OF THE WEST SIDE OF THE PRINCIPAL SANCTUARY OF TJANDI LORO DJONGGRANG.

"The operation, owing to the practiced hand of the workman, is, further, performed quite rapidly. A brazier of live coals upon which are placed a large number of these reservoirs at once is located near the workman, who thus always has at hand a supply of liquid boiling wax. The fabric has now been covered with wax in certain parts, while the others remain intact. In this state it is delivered to the dyer, who puts it into a bath, say of a red color, made with 'manboukou,' a powder extracted from the bark of the Morinda citrifolia, a tree belonging to the order Rubiaceæ. The dye takes everywhere upon the parts of the stuff that have not been treated with wax. The fabric is then allowed to become very dry. The wax is afterward easily detached after two days' soaking in cold water. The design that it covered reappears in its entirety, as white as the calico itself, and standing out upon a red ground. The figures that remain white have to be set off with indigo blue tones, and it is therefore necessary to cover the fabric with wax a second time at every point where the blue is not to appear upon the design, and to immerse it again in the dye bath. It will now have been decorated with three colors, red, indigo and white. For each tint to be given, there is an operation to be begun again in the same way and which is a very delicate one, on account of the fineness of the outlines and the abundance of the colors. It will be easily understood how lengthy and detailed all these various rehandlings are, especially when we consider the odd and complicated decoration of these pretty fabrics. They always display great taste and are very harmonious in coloring, and this is their greatest merit. Fig. 3 shows the interior of one of the studios in which are designed these sarrongs, the dimensions of which are about one yard by two yards. In order to dry them, they are exposed upon frames. Women are often employed in the drawing of the designs. To the left in the engraving we see one of them occupied in making the first sketch upon the calico. Other fabrics have received a first or a second dye, and women are covering them with wax in order that they may receive another color. Fig. 2 shows a curious fragment of such designs upon calico representing 'wajangs' (Chinese shadow puppets) simulating a conversation enlivened with the expressive gestures employed in pantomimes."

We shall now take from the book under consideration a description of the ruins of a celebrated Javanese sanctuary, that of Tjandi Loro Djonggrang (Fig. 4).

"In consequence of the gradual excavation of the earth that hid the ruins, the principal sanctuary of Tjandi Loro Djonggrang, consecrated to the god Siva, is now uncovered (as are those that surround it) and is to be seen in its entirety. Fig. 4 gives the aspect of

FIG. 2.—DESIGNS FORMED UPON FABRICS WITH MELTED WAX.

the west side of this sanctuary. Away at the back, in the little sacred hall, we distinguish the statue of Gonesh, the son of Siva and Parvati. It is, so to speak, complete, and is still enthroned under the vault, which remains intact. The temples of the principal platform and the small sanctuaries of Tjandi Loro Djonggrang, elevated in three rows along the second inclosure, constituted a necropolis, the simple and very pure composition of which must have produced quite an effect. The kings of Matavam, the high priests and the royal princes were, according to all probability, buried toward the eighth century of our era in these sacred places, which are now designated by the group name of 'lemptes of Prambanam.'"

We shall conclude here, having been obliged to limit ourselves to giving a few specimens only of the work that Mr. Tissandier's third voyage inspired.—La Nature.

The latest production of the watchmakers of Switzerland is a watch whose hands move from right to left instead of from left to right, as in ordinary watches. These watches are designed for the markets of Turkey, Japan and other Oriental countries, where the natives read from right to left, and where there has been a demand for watches of this character. This watch is the invention of a Geneva watchmaker, who has covered it by Swiss patents, and who has applied or is applying for patent rights in the United States. The watch moves with perfect precision, and seems to be in all respects quite as good as other watches.

In the Moniteur de la Ceramique et de la Verreries an account is given of a new and attractive product—a glass plate of different colors—the manufacture of which is as follows: Upon a table provided with several rolls a certain quantity of glass is poured, which is leveled to the desired thickness either by moving the table or the lower roll; upon this plate, but before it has cooled off, another quantity of glass is poured, which, leveled with its respective roll, forms a second layer adhering perfectly to the first. If the two glass substances are of different colors, the plate obtained consists of glass of two colors, one upon the other; and a plate of more colors can be produced in the same way. By moulding or pressing, letters or designs of any shape or dimensions can be represented, the impression being accomplished either by the flattening roll or another one running behind it, or, still better, by the vertical pressure of an engraved plate, or with cast designs and inscription.

ANCIENT TOYS.

A BABY'S toy to be fully appreciated must certainly be something that it can safely bite, and next in order of merit come rattle and glitter. The baby's rattle of fifty years ago of silver and coral, with little bells, admirably fulfilled these conditions, and an especially fine specimen was figured some years ago in the London Queen, to which which we are indebted for the cuts and copy, as being exhibited in the Guelph Exhibition, and having ministered to the infant happiness of George IV.

The same tastes were evidently shared by the babies of past ages, and numerous forms of rattles and clappers now exist, dating from very early times. At Pompeii and Herculaneum, cities of Campania in southern Italy, which were covered up with ashes from Vesuvius, A.D. 79, and excavated in recent times, have been found several specimens of rattles, pieces of wood with a small hinged tongue, handles carrying small hoops strung with resounding balls of metal, and other kinds of sound-producing toys.

But perhaps the most beautiful form of rattle is to be seen in the miniature sistra from Egypt, of porcelain (No. 1), wood or bronze, which were very probably used to delight the little children on the banks of the Nile. They are sometimes ornamented and sometimes plain, and were originally strung with bars of wire bearing small ringing disks of metal.

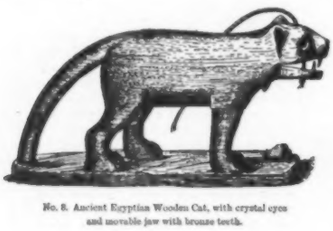
The Greeks, who called babies' rattles generically by a name signifying "Producers of sleep," invented an orginal and interesting form consisting of small terra cotta models of various objects, vases, animals, or birds, having a small hollow within them, in which was inclosed a ball of metal. Naturally, when one of these was put into the hands of a baby the constant ringing and rumbling noises must have been most satisfactory, and its name, "Psephoperibombetrian," shows clearly enough that its special virtues were also fully appreciated by its godfathers.

The Greek children were made to keep their toys very carefully, and no doubt, from the mentions of such things that occur now and then in classical authors, many of them were not only pretty but valuable. They were put into baskets specially made and kept for them, and were considered to be under the protection of Bacchus, unless they were particularly dedicated to some other deity. This dedication, which was usually the ultimate fate of the toy basket, generally took place, with the aid of many ceremonies, on the marriage of its owner.

In one of Plautus' comedies, "Rudens," the possession of one of these baskets of toys enables the young girl Palæstra to establish her identity. She was kidnapped when a child, with her basket, which she carefully preserved; and when she was grown up she came across her parents, and on examining her toys they recognized their daughter. Among these treasures of childhood was a little golden sword engraved with her father's name, a little golden ax engraved with her mother's name, a small silver sickle, two clasped hands, a small pig and a golden pendant.

The earliest toys, except, perhaps, some of the Egyptian ones, are probably to be found among the archaic terra cottas found at Mycenæ, Rhodes, and Tiryns (No. 2) and others of a not much later date from Athens (No. 3). These are modeled by hand, and bear upon their surfaces patterns drawn in red or black pigment. They are sometimes considered models only, but, as likely as not, many of them are children's toys, and for a child grown out of its baby rattles and dolls, what more delightful treasure even now than a horse and cart?

Dolls of endless kinds have clearly been chief among toys for a very long period. From ancient Egypt many of them have lasted till the present day, made usually of a piece of flat wood, painted with various designs in colors, and cut roughly into the shape of a human figure. Some of these have hair made of pellets of clay (No. 4); others are made more accurately to the natural model, and were probably intended to be dressed. Bronze dolls also were made with movable arms. The most beautiful of all dolls are, however, to be found among the Greek terra cottas, especially those which have been found packed in large earthen jars in the tombs at Tanagra, in Bœotia; these are numerous enough, and vary much in their beauty; several of



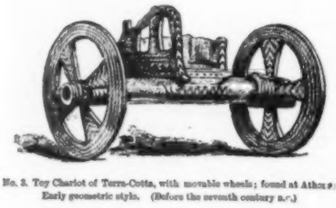
No. 8. Ancient Egyptian Wooden Cat, with crystal eyes and movable jaw with bronze teeth.

No. 2. Biga, or Two-horse Chariot, found at Ialysos, in Rhodes, of the Mycenæ period (before the seventh century B.C.).

No. 4. Ancient Egyptian Wooden Doll, with hair made of pellets of clay.

No. 5. Terra-Cotta jointed Doll, holding a rattle; from Tanagra. (About sixth century B.C.)

No. 6. Terra-Cotta Doll, with jointed arms; found at Myrina, in Asia Minor. (About third century B.C.)



No. 3. Toy Chariot of Terra-Cotta, with movable wheels; found at Athens. Early geometric style. (Before the seventh century B.C.)

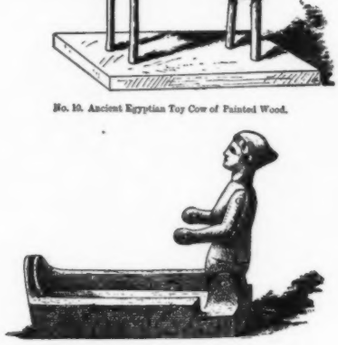
No. 11. Coloured Toy from Tanagra. Boy on swan. (About sixth century B.C.)

No. 9. Ancient Egyptian Movable Toy. Man kneading bread.

No. 12. Small Terra-Cotta Ship, with warriors; found at Corinth. (About 600 B.C.)

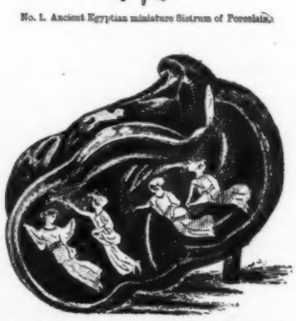
No. 13. Ancient Greek Bronze Toy; found at Corinth. (About sixth century B.C.)

No. 10. Ancient Egyptian Toy Cow of Painted Wood.



No. 7. Movable Terra-Cotta Toy; from Tanagra. (About sixth century B.C.)

No. 1. Ancient Egyptian miniature Sistrum of Porcelain.



No. 15. Black and Red Greek Vase, in shape of a knucklebone. Found at Ægina. (About fourth century B.C.)

No. 14. Greek Girls Playing with Astragali. Terra-cotta group. Found at Cyprus. (About 3d century B.C.)

them are jointed in all their limbs (No. 5), and others are only jointed at the shoulder (Nos 6 and 7). Many of these beautiful figures have been colored, but in many instances this has rubbed off. They were made in moulds, and afterward finished and altered by hand. Both Greek and Roman dolls seem to have been made of wood, wax, and rags, and toy chariots were also made of leather, but none of them have survived.

Many movable toys have been found in the tombs of ancient Egypt—birds with waggling heads, people making bread, alligators with moving jaws, cats also with moving jaws (No. 8), and many others (No. 9), all working by means of a piece of string. Besides these are numberless models of animals in bronze, wood (No. 10), and porcelain, and playing balls of papyrus, cotton, bran, and leather strips, all of them generally covered with leather.

From the Greek tombs at Athens and Corinth and Tanagra come other models and toys of terra cotta, besides the dolls. Several of these are very curious—quaint figures on horseback or riding on birds (No. 11); baskets of fruit or fish, sometimes put on horses' backs; and odd little figures making bread, ships with shielded warriors (No. 12), and many others. And at Corinth a specimen of an especially pretty toy in bronze has been found, consisting of a long handle, having at its end a circular revolving disk, evidently for the little Greek boy or girl to run with. The disks are double, and have sometimes a repoussé pattern upon them. It is possible that originally a small metal ball may have been contained in the hollow disk, which would have made a pleasant tinkling as the little disk turned round (No. 13).

The game of Pentelithi or five stones, played ages ago, is still to be seen in our streets to-day. Painters and sculptors have recognized fully the beauty of this game, and frescoes, paintings on vases, sculptures, and models in terra cotta (No. 14) and bronze are not uncommonly found. It was played with small stones or astragali, these last being the ankle, huckle or knuckle bone of a sheep, and a curious and beautiful black and red Greek vase, painted with a charming group of dancing girls, is made on the model of an astragalus (No. 15). Although played by children as a game of skill, the astragali were also used for gambling purposes by grown-up people, and the flat sides of the bones were marked with various values, and used like our dice. But the games of older children hardly come within the scope of the present paper, although they were many and interesting. It is, however, clear that small children are among the most conservative of mortals; indeed, any one of the most ancient toys I have ever been privileged to examine would be quite acceptable in the most modern nursery.

THE CHRONICLES OF FROISSART.*

THE chronicles of Froissart resemble in one respect an object of interest in one's own city or country which has not been visited because it can be seen any day. Froissart is a familiar name from one's childhood days, but how many have any real acquaintance with the early chronicler? There is no longer any excuse for ignorance or lack of acquaintance with this early courtier for a charming book has recently been published in England, and we republish two of the charming prints with which the work is embellished. The St. James's Budget, in a review of the work given below, hardly gives the author, Mary Darmsteter, the credit due, for the work gives an admirable picture of the times and charming reading. The Budget says the book is easily read, printed in such bold type and on such unusually thick paper that two such books could be read by the diligent reader in a single morning. It has also a number of illustrations, some of which are very well done, and which serve quite as much as the subject matter to throw light on the events of those times. Viewed, however, as a biography of the great chronicler, we are slightly disappointed to find the number of things that are still untold us about his life. If, however, we read it as throwing light on the affairs of nations of the fourteenth century, there is something we can add to our stock of information. No one seems to know the exact year of Froissart's birth, nor anything of his antecedents; we are only told he was like other children in his love of games and his dislike of study. In Froissart's time romances were written in French, serious books in Latin. English was merely a patois without elegance. The fourteenth century shortly altered all this, and, curiously enough, we read that in 1362 the assizes were held in English. An interesting account is given us in Chapter III of the London of Froissart's day, full, as it were, of illustrious French captives with their splendid retinues; and a compliment is paid to our countrymen. "These gentlemen beyond the sea have an absolute reliance on the word of honor, often allowing their prisoners to depart on the faith of a simple promise to bring back their ransom in three months, in a year, or at any other fixed period. Such has never been the habit or courtesy of the Germans," Froissart tells us. "I do not know what they will do henceforth, but until now they have shown neither mercy nor pity to Christian men at arms, be they nobles or gentlemen. But, when they take them they put them in irons or prisons . . . and all for the sake of a better ransom." We are glad to think that Englishmen knew how to respect valor, and how to treat those taken prisoners in honorable warfare. The chapter on Meliador will be read with special interest. There we are reminded that the romance that Froissart read each night at the court of Gaston Phœbus will shortly, after a disappearance from the world of four centuries, see the light of day again. M. Lognon, about two years ago, while examining certain judicial registers bound in old parchment, discovered in these bindings fragments of Meliador. Subsequently he discovered that he had the romance of Meliador almost in its entirety. This poem, with over 20,000 lines, is a formidable task to copy, yet it is being copied by M. Lognon. We are not surprised that thus far two persons only have read a poem longer than the Iliad, and reminding one of Spenser's Faëry Queen. The ordinary Englishman will probably read the romance as given by our author in the chapter on Meliador, and will agree that the writer's power of imagination was vivid indeed, and that it is a romance worthy of the middle ages.

* Froissart, by Mary Darmsteter, translated by E. Frances Poynter. Charles Scribner's Sons, publishers.

THE RECEPTION OF THE BLACK PRINCE AT BORDEAUX.

QUEEN ISABELLA ON HER JOURNEY TO ENGLAND.

REPORT OF THE COMMISSIONER OF PATENTS FOR THE YEAR 1895.

IN 1895 there were received 39,145 applications for patents, 1,463 applications for designs, 72 applications for reissues, 2,415 caveats, 2,112 applications for registration of trade marks, 293 applications for registration of labels, and 13 applications for prints. There were 21,998 patents granted, including designs, 59 patents reissued, 1,829 trade marks registered, and 3 prints. The number of patents which expired was 12,345. The number of patents which were by operation of law forfeited for nonpayment of the final fee was 3,428. The receipts of the office were $1,245,246.93; the total expenditures were $1,084,496 51. The receipts over expenditures were $160,750.42, and the total balance to the credit of the Patent Office in the Treasury of the United States amounts to $4,529,886.33. In every year since 1861 there has been a surplus over all expenditures, and in every year but eight since the foundation of the Patent Office, on its present basis, in 1836, there has been a surplus.

In proportion to population more patents were issued to citizens of Connecticut than to those of any other State—one to every 927 inhabitants; and next in order, in proportion to population, come the District of Columbia, with one to every 1,047; Massachusetts, with one to every 1,248; Rhode Island, with one to every 1,528; New Jersey, with one to every 1,619; New York, with one to every 1,694; Montana, with one to every 1,915; and Colorado, with one to every 1,917. The States to whose citizens fewest patents were granted in proportion to the number of inhabitants are Mississippi, one to every 34,854; South Carolina, one to every 28,076; North Carolina, one to every 24,891; Alabama, one to every 16,626; Georgia, one to every 16,117; and Arkansas, one to every 15,042. Some were issued to citizens of every State and Territory in the Union.

As to foreign countries, 614 patents were granted to residents of England, a larger number than to residents of any other foreign country; to those of Germany, 539; of the Dominion of Canada, 302; of France, 202; of Scotland, 50; of Austria-Hungary, 46; of Switzerland, 42; of Sweden, 30; of Russia, 29; of Victoria, 21; of Mexico, 17; of New South Wales, 17; of Belgium, 16; of the Netherlands, 16; of Denmark, 11; of Italy, 11; of Norway, 11; of Ireland, 10; of South Australia, 10; of New Zealand, 9; of Hawaii, 5; of India, 5; of Cuba, 4; of the South African Republic, 4; of the Argentine Republic, 3; of Spain, 3; of Venezuela, 3; of Algeria, 2; of Brazil, 2; of Chile, 2; and one each to citizens respectively of Bermuda, British Guiana, Cape Colony, Ecuador, Finland, Greece, Guatemala, Nicaragua, Peru, Porto Rico, San Salvador, Tasmania, and Turkey.

ACTIONS OF THE OFFICE.

The office received for action not only the 42,792 original applications for patents, for designs, for reissues, and for the registration of trade marks, but also 88,700 amendments of applications and other writings from applicants, which put the cases to which they appertained into condition for further action by the office. This is an average of 823 original and 1,650 amended cases received each week. On December 31, 1895, there were pending in the office 4,486 new applications, including trade marks and designs not acted on, and 5,671 amended cases not acted on, a total of 10,157.

PROSECUTION OF CASES BY APPLICANTS.

Rules for the expedition of business in the Patent Office were made by the commissioner with the appro-

val of the Secretary of the Interior, and were in effect on and after April 15, 1895, as follows:

65. An applicant will be considered to persist in his claim for a patent without altering his specification in case he fail to act in prosecution of the same for six months after the office action thereon, and thereupon the examiner will make a re-examination of the case.

134. In appealable cases in which no limit of appeal is fixed, no appeal will be entertained by any tribunal in the office unless taken within six months from the action which puts the case in condition for appeal, unless it be shown to the satisfaction of the commissioner that such delay was unavoidable.

68. In every case pending before the office more than five years, in which the record raises the presumption that there have been intentional delays in prosecution, the examiner may require the applicant to show cause why the case was not more rapidly prosecuted, and at the hearing thereon or upon failure of the applicant to appear the examiner will determine, under all the circumstances of the case, whether there have been intentional and unreasonable delays in prosecution, and upon finding the fact to be so, he will reject the case for that reason.

The considerations which led to the adoption of these rules were adverted to in my last report to Congress, and the fact which seemed to call for their enactment was stated to be that on December 31, 1894, there were found to be pending in the office 50,507 cases which had been acted upon, many of them repeatedly, and which nevertheless were awaiting amendment or appeal or other proceeding in prosecution on the part of the applicants. Twelve thousand of these applications had been pending two years or more; 1,514 had been pending five years or more; 130 had been pending ten years, and 5 had been pending fifteen years. In nearly all of the older applications there was found to be a systematic, repeated, and evidently intentional delay of nearly two years in responding to the action of the office.

On December 31, 1895, there were pending in the office 43,648 cases which had been acted on by the office and which were awaiting further attention on the part of the applicants. Of these, 11,198 applications had been pending two years or more; 1,398 had been pending five years or more; 92 had been pending ten years or more, and 31 fifteen years or more. Here is a reduction of 6,859 in the number of cases before the office not disposed of.

The new rules have been applied by the office with great conservatism and with an anxious regard for the interests as well as the rights of inventors, and it may be said at this time that there is general acquiescence in their validity on the part of the ablest and most thoughtful attorneys. Nevertheless, it cannot be denied that they are open to attack in the courts, upon the question of their validity, and regarded as a matter of policy they are also liable to repeal. On the latter consideration and because there can be no doubt of the beneficence of the rules, it is respectfully recommended that they be enacted into law, either in their present form or by a declaratory act interpreting the present statute and in terms conferring upon the Commissioner of Patents the authority to reject a case where it is found that the applicant has intentionally and unreasonably delayed its prosecution.

SCIENTIFIC LIBRARY.

During the past year, at the request of this office, circulars were sent out by the Department of State to the diplomatic representatives of the United States residing abroad, with a view to obtain copies of all patents issued by foreign governments, and for other information respecting their official journals relating to patents. Replies have been received from the Barbados, British Guiana, British Honduras, Ceylon, Chile, Finland, Guatemala, Hawaii, India, Jamaica, Luxemburg, Malta, Mauritius, Newfoundland, Portugal, Queensland, St. Helena, Straits Settlements, Tunis, Venezuela, West Australia, Victoria, New Zealand, New South Wales, Tasmania, and South Australia. As a result, the library now has a record of 981,961 patents issued by foreign countries, being an increase of 117,261 over 1894, when 864,700 were reported. Of these, 939,750, or nearly 96 per cent., are in the form of publication adopted by the country of issue—that is, by title, or by abstract, or in extenso; 647,600, or 69 per cent., are available for examination, being published in full and accompanied by drawings; 178,150, or 19 per cent., are partially available for examination, being published in abstracts, and 114,000, or 12 per cent., are published by title only.

The patents of these foreign countries have been secured on the basis of an exchange of certain publications of this office, and in this connection I call attention to the fact that out of the $2,000 which is the present meager appropriation for the scientific library we pay between $400 and $500 for the transportation of our publications and patents to foreign governments; this expense will be further increased during the ensuing year.

This library, although comprehensive in its possession of scientific works, lacks some 4,000 volumes which are considered necessary for its equipment as a library of reference for the examining corps. The estimated cost of these publications is about $10,000, and I recommend that the appropriation be increased to that amount.

THE PATENT BAR.

In a former report I had the honor to recommend that authority be given to the commissioner to frame rules, subject to the approval of the Secretary of the Interior, for the admission of practitioners before the office to an organization to be designated the patent bar. Further reflection has led me to attach increasing importance to this measure, and has induced a belief that a noticeable evil from which inventors and the public suffer would be mitigated, if not almost removed.

It would be a manifest injustice to establish a patent bar to be composed exclusively of lawyers. Some of the most capable and honorable solicitors practicing before the office have chosen other professions than the law, and it not infrequently happens that the mechanical expert is as well qualified to conduct the work of a solicitor before the office as those who conduct at the same time a patent law practice before the courts. No suggestions now made or that have been heretofore made had any thought of excluding men of this class from any of the privileges of the proposed patent bar.

It not infrequently happens that a practitioner, perhaps under the stimulus of a contingent fee, has so presented a meritorious invention that no adequate claims are found to be allowable, while yet one letter claim has been allowed. It is obvious, on careful inspection, that claims might be drawn which would cover the invention and thus secure to the inventor that which was his own, and which would be allowed in a later action on the case; but instead of bestowing the requisite attention and labor upon the case, the unfaithful solicitor promptly directs the cancelation of all claims objected to, and thus puts the application into condition for allowance with an inadequate claim. Again, the unscrupulous solicitor takes an appeal, or a series of appeals, upon a case that is squarely and indubitably met by the references, for no assignable reason other than to secure from some unlettered client the appeal fee; for in such cases, though the appeal be regularly taken, no appearance is made before the appelate tribunal, no brief is filed, and the inventor is left in no better state, but somewhat the worse for this petty system of plundering. Another class is not infrequently seen about the elevator in the Patent Office, lying in wait for those who have traveled hither for the purpose of presenting their inventions in person. They are without a known place of business other than the attorneys' room in the Patent Office; and against all these the establishment of a patent bar would provide a barrier, and it would, to some extent, insure to inventors a guarantee that those who have a right to practice here are men of recognized integrity and of ascertained fitness and capacity.

As matters now stand, any one who has not been proved before the Patent Office to have retained the money of his client or to have been guilty of other gross misconduct, and so refused recognition under section 487 of the Revised Statutes, is permitted to practice before the office, whatever his attainments may be, whatever his character or capacity.

It is thought that a conservative regulation upon the subject of admission to practice before the office is necessary for the protection of inventors against the greed of some who, as patent agents, solicit their business, and against the incompetence of others.

I therefore respectfully recommend that authority be given by legislation for the enactment of rules and regulations concerning the admission to a solicitors' bar of those entitled to practice before the Patent Office.

THE RECOMMENDATIONS OF THE PATENT COMMITTEE OF THE AMERICAN BAR ASSOCIATION.

My attention has been called to a bill which has been carefully prepared by the patent committee of the American Bar Association, and which has recently been introduced into the House of Representatives under the title "H. R. 3014, a bill revising and amending the statutes relating to patents," introduced by Mr Draper, the chairman of the House Committee on Patents. Some of its provisions concern procedure within the Patent Office, and are therefore referred to in this place.

The first section of the bill under consideration limits the time within which an application may be made in this country, by either the foreign inventor or any other, to two years after the matter has been patented or described in any printed publication in this or any foreign country.

In a former report I had the honor to recommend that section 4887 of the Revised Statutes be amended by erasing all that part of the section which limits an American patent to the term of any foreign patent which may have been taken out by the same inventor or in his behalf, to the term of such foreign patent. This law has been found to work serious hardship, and leads inventors to refrain from taking out patents in foreign countries rather than to take an American patent with a limited term. It is thought that the true policy is to lay no obstacles in the way of the taking of foreign patents and to encourage that course rather than the contrary. Wherever the invention has been patented in a foreign country the limitation of the right to apply in this country to two years after such foreign patent has issued will cut off the evils at which section 4887 was principally aimed, and avoid the mischief resulting from an uncertain term to American patents with the attendant litigations growing out of such a state.

The provision of section 4 of the bill for the amendment of section 4894 of the Revised Statutes, reducing the period within which applications shall be completed and prepared for examination from two years to six months, appears to be directed to an evil that has been long recognized in the office, and if enacted, this provision must certainly reduce the possibilities of intentional delay in the prosecution of applications for patents. This subject, however, has been heretofore treated in this report, in discussing the prosecution of cases in the office and the operation of the new rules.

I respectfully recommend the enactment of this bill into law.

ROOM.

The need and importance of providing the Patent Office with more room have been successively urged upon the Congress by every commissioner for the past twenty years, and it seems almost a work of supererogation to add anything to their earnest appeals. But I should ignore my clear duty to inventors and to the public should I omit to call the attention of the present Congress to this subject, and to the totally inadequate accommodations allotted to this bureau, and to the further fact that the public business is greatly retarded in consequence of the limited and inconveniently arranged space.

Senate bill 429, introduced during the present session, authorizes the construction of a building for the use of the Patent Office. Either the provisions of that bill should be enacted into law or this entire building should be made available for the exclusive occupancy of the Patent Office. Every room in this building is absolutely required for the transaction of its business. A cursory investigation of the present situation will demonstrate that some change in the arrangement between the bureaus occupying this building is imperative. The force of the Patent Office is scattered in remote parts of the building; its valuable records are disposed upon all the floors and are at all times exposed to the danger of conflagrations and other loss; there is apprehension that the galleries are overloaded beyond the safety limit, and the sanitary conditions in many of the rooms are a constant menace to health.

Under the act of July 4, 1836, section 7, the construction of this building for the accommodation of the Patent Office was begun. The act of March 3, 1849, created the Department of the Interior, and the General Land Office was transferred from the Treasury Department to become one of its bureaus. This new department took possession of the east wing of the building. The west wing was erected under the act of August 31, 1852, and when ready for occupancy in 1856 the Land Office moved in. From that day to the present all the desirable rooms on the main floor have been occupied by the force of officers other than the Patent Office, which bureau has taken by grace what little was left. The building has been diverted from the original purpose; the bureau for which it was intended has been crowded and in every way inconvenienced, and this notwithstanding the fact that a large part of the money used in its construction was paid into the Treasury by inventors. This of itself is an unanswerable claim in their behalf that proper facilities for the transaction of their business shall be provided. When they bring their work to this office they pay for its performance in advance, and these fees more than exceed every year all the expenses incident to the maintenance of the office. The government is not less obligated and bound in honor to promptly and efficiently perform the work brought to it than is an individual who receives in trust money for certain uses and purposes. Irreparable loss frequently follows delays within the office, and important interests are sacrificed. It is only when a patent is finally granted or refused that an inventor receives the full consideration for his money. I submit that many criticisms would be avoided if the Congress would properly equip this office with the necessary facilities to enable it to dispose of its business.

By the act of March 3, 1891, Congress appropriated $16,000 for the rent of a building for the General Land Office. During July of that year a small part of the force of that bureau was removed from the building and fifteen rooms were vacated. Six and one-half rooms were in consequence turned over to the Patent Office, but were principally used to provide for the two new examining divisions at that time authorized by Congress to be established in this office, leaving the old force in the same crowded condition. So much opposition was developed against the Land Office leaving this building that less than one-fifth of the $16,000 was used. There appears to be no doubt that it was the intention of Congress at that time to provide for the removal of that entire bureau from the Patent Office building.

The slight relief was only temporary, for at the end of that fiscal year the outstanding force of the Land Office was brought back into the Patent Office building. In order to accommodate that bureau and also to meet the urgent demand of this office for additional room, the Acting Secretary of the Interior, in July, 1893, caused to be removed from the Model Hall in this building to the Union building on G Street about 80,000 models, forming part of the record in patented cases. This measure was considered to be a temporary expedient. The advantages hoped for were more than offset by the disadvantages. These valuable exhibits are to-day practically inaccessible to this office and to the public, and whenever practicable they should be brought back into this building, the wooden partitions in the Model Hall removed and the space restored to the uses and purposes originally intended.

AN EXHIBITION HALL FOR MODELS.

The Chicago and Atlanta expositions opportunely suggest that definite steps should be taken for the maintenance of a gallery, to be located at the seat of government and in the spacious Model Halls of this building, for the display of the arts and manufactures of this country, and where the 158,000 valuable models now in the custody of the Patent Office may be fittingly deposited. New models and exhibits at the inception of any new art would be added to this collection, and in a brief time there would be open for the public benefit and without expense to the government a display of skill, ingenuity and effort unsurpassed by any like exhibition in the civilized world. I fully agree with my predecessor, Mr. Commissioner Mitchell, that it was a public calamity when the office was compelled to suspend receiving models for lack of space in which to exhibit them. Most important inventions have been made since that time, and at the close of the Chicago Exposition, through the co-operation of manufacturers and inventors, this office secured many complete exhibits. If the office were in possession of sufficient space, all these exhibits and patented models could be attractively arranged so as to make a historical exhibit, illustrating step by step the development of the arts and one which would be of international interest and of inestimable value. The effect upon the industrial and intellectual world of making this office a repository for working and illustrative models to attest the progress of science and the useful arts would be broad and deep. It has become history that in all periodical depressions the revival of business is first seen in the activity of industrial enterprises.

Prior to 1870 the United States issued 108,416 patents and the total number of patents issued by the foreign countries prior to the same date was 222,615. Since 1870 and up to December 31, 1895, a period of twenty-six years, the United States issued 454,042 patents, and foreign nations in the same period issued 759,346 patents. The total of all patents issued by the United States is 562,458, and the total issued by the foregoing foreign countries is 981,961.

Prior to 1870 the United States issued nearly half as many patents as all foreign nations combined. Since 1870 the United States has issued more than half as many as all foreign nations combined, and in the aggregate of patents issued in both periods, the United States issued more than half as many patents as all foreign nations combined. The total number of patents issued by the United States and the foreign nations prior to 1870 of which the office has a record was 331,031. The total since 1870 is 1,213,388, and the total

number of patents issued by the United States and the foreign countries herein considered is 1,544,419.

It may be said without offense that most of the civilized nations of the earth have patent systems, notable exceptions being China, Holland and Greece. Many have been recently established. As a function of government the patent system is wholly unique. It cannot be compared with a system of public education, wherein the government undertakes to promote the general well being by educating the individual. It is wholly unlike the pension system, which seeks to reward past sacrifices. It is a new feature of the modern world, and its laws and instrumentalities have rapidly developed into a vast system. Its past and present are imposing, its results are far reaching and beneficent, its future is full of promise. It is a satisfaction to note that the American patent system is generally conceded to be the most perfect in the world.

INVENTORS WHO HAVE TAKEN OUT MORE THAN ONE HUNDRED PATENTS EACH.

During the past twenty-five years the office has granted to each of twenty-five inventors more than 100 patents, the whole number granted to those inventors within the time mentioned being 4,394. Of these the highest number received by one individual was 711, and the lowest 101, the average being nearly 196. They are as follows:

Edward J. Brooks, 116; George D. Burton, 128; Luther C. Crowell, 147; Peter C. Dederick, 107; Thomas A. Edison, 711; Rudolph Eickemeyer, 158; Louis Goddu, 131; Rudolph M. Hunter, 238; John W. Hyatt, 198; Hiram S. Maxim, 131; Arthur J. Moxham, 144; Lewis Hallock Nash, 119; Edwin Norton, 125; Feeborn F. Raymond, 2d, 144; George H. Reynolds, 101; Francis H. Richards, 343; Cyrus W. Saladee, 148; Walter Scott, 109; Charles E. Scribner, 248; Sydney H. Short, 111; Elihu Thomson, 394; Charles J. Van Depoele, 244; George Westinghouse, Jr., 217; Edward Weston, 274; William N. Whiteley, 118.

CLASSES IN WHICH THERE HAS BEEN SPECIAL ACTIVITY IN THE PAST YEAR.

Invention appears to go in waves. While in none of the 214 classes in the office is there ever complete stagnation, and while in many there is a steady and regular average of work, in some others a noticeable increase in the number of applications will be for a length of time displayed.

The relation which exists between industrial demand and inventive activity is very close. Each may be said to be dependent upon the other. In any line in which there is little or no call there will be but little inventive effort. On the other hand, should any change or advance in industrial conditions cause a sudden increased demand for some article, means for producing that article or its equivalant will be created very rapidly in the brains of ambitious inventors. Thus, upon the adoption of house letter boxes a few years ago, the office received in a few months several hundred applications for devices of this kind. A short time ago there appeared in various journals throughout the country articles setting forth the desirability of a bottle which could not be refilled after it was once emptied. The result, so far as the office is concerned, was the receipt of about 1,000 applications.

During the past year there has been exceptional inventive activity in baling cotton in closely compacted cylindrical bales, instead of in rectangular bales; in pneumatic straw packers, blowing the straw on the stack and packing it at the same time, thus dispensing with disagreeable hand labor, and in the treatment of wool fat, until recently regarded as a waste product.

There has been exceptional activity in excavators, possibly due to the beginning of several large enterprises, especially the Chicago Canal. There has been activity in the extraction of aluminum by electrolytic action and, to some extent, in the extraction of gold by the use of potassium cyanide. The class of pneumatic drills for cutting stone has shown considerable activity.

The greatest activity has been displayed in detail inventions and accessories to bicycles and in machines and processes for making the parts, due, perhaps, in part to the enormous accession of thinkers to the ranks of those who use them. Pneumatic tires have attracted the inventor, because of their now almost universal use on sulkies as well as bicycles. For some unknown cause there has latterly been great activity in sole leveling machines, used in the manufacture of shoes. There has recently been great activity in inventions in telephones, due, as is supposed, to the expiration of pioneer patents, and not a little in electric locks, a new art. Alternating current motors and other machines employing the alternating current have latterly been the subject matter of increased inventive thought.

Car fenders and car couplers, and particularly automatic couplers of the Janney type, and burglar proof express cars have shown exceptional activity. Automatic musical instruments have attracted attention, due possibly to the substitution of perforated paper for cylinders with pins, and a consequent reduction in cost.

Games and toys, pearl buttons, wire glass for skylights, can labeling machines, central draught lamps, and curling irons have shown great activity. Match making machines, calculating machines, and voting machines have shown special activity, the latter due probably to new systems of voting. Linotyping machines and typesetting machines have latterly shown extraordinary activity. In the artificial carbonation of beer there has been a notable development, based upon the recent discovery that beer can be artificially carbonated and a second fermentation dispensed with.

THE CLASSIFICATION DIVISION.

I have deemed it my duty repeatedly to call the attention of Congress to a matter which in the evolution of the system has become a most pressing and urgent need and which concerns its proper development, its due and reasonable administration, and the want of which is the source of evils and oppression to the public and loss to individuals.

While all patents are prima facie valid, no patent will be finally sustained by the courts which purports to secure to the grantee the exclusive use of an improvement which has been before patented in this or in any foreign country, or which has been described in any printed publication in any language before the invention thereof by the patentee. It is therefore necessary that the accumulated records of the world shall be closely and scientifically classified, so that not only the office but its patrons, whether inventors, solicitors or the public, may quickly and with reasonable certainty know what is disclosed in the records of the prior art. This matter is already classified in the Patent Office with great care, and yet not with that full perfection which is reasonably attainable at a moderate cost. In the rapid growth of the industrial arts and in the enormous accumulation of granted patents, and in the absence of any specific assignment of this close and discriminating work of classification to a particular and well organized division, there have crept in errors and there remain deficiencies, almost entirely preventable, and yet inevitable from the vast avalanche of records. The exigencies of the office demand a thorough revision of the whole classification.

From the most careful and solicitous investigation I have no hesitation in saying that with a well equipped division of trained and experienced examiners, devoted exclusively to the work of classification, this matter, vast as it is, may be so arranged that no patent will be issued without an inspection of all that is in print pertaining to the same art.

It has sometimes been said that the work of classification and examination has now become so great that it cannot be effectively performed by the Patent Office, and that it were better to issue all patents without examination as to novelty, leaving the work of sifting the records of the prior art to the courts. But I venture to say that this would be a most expensive system to inventors, and one that would entail great loss in many cases, in that errors, when discovered by the courts, are, as a rule, beyond correction. It would then not infrequently happen, as it now occasionally happens, that a meritorious invention, in ignorance of the achievements of others, would claim too broadly, and while patentable substance would be found and admitted, the claims would be declared invalid, and the patentee take nothing, instead of the legitimate reward of his genius. It must, then, inevitably happen that in most cases, before a final decision would be reached, the invention would have gone into public use for more than two years, so as to preclude a new application which could be allowed. The reissue statutes afford but partial relief, and are inapplicable in many cases of great hardship. And were it so that patents were granted without examination by the Patent Office, it would still be more than ever important that there should be some public office where the records could be examined by solicitors and inventors, so that they might suitably restrict their claims to that which differentiated their achievements from the prior art.

I regard even the somewhat large expenditure of $64,500 a year for the estimated period of five years required for the completion of this work as a most just and proper expenditure, literally exacted by the development of the system, as a necessary addition to the equipment of the office, and a just appropriation of a part of the accumulated fees received from inventors over and above the annual expenditures of the office in the administration of the system.

It may be further stated that there is a general tendency of patent systems as established in other countries toward the American system of examination into the novelty of inventions before the grant of a patent, and the rejection of claims not warranted by the state of the prior art. It is becoming the practice of some foreign solicitors before making application for a patent in their own country to make application in important cases in the United States Patent Office, for the purpose of getting the results of the search which is here made. For this search, with whatever of imperfection exists by reason of the enormous recent expansion of the industrial arts, is yet the most perfect search that is attainable anywhere in the world at anything comparable to the moderate expense attending the work here.

I therefore again most soberly and urgently commend to the Congress the bill establishing the classification division which has been introduced by the chairman of the House Committee on Patents, and which at this writing has been unanimously recommended and favorably reported by the House Committee on Patents.

The report is concluded with a historical review of the prominent inventions of the last twenty-five years.

SELECTED FORMULÆ.

To Preserve Paste and Mucilage.—At the Konigliche Lehranstalt fur Obst und Weinbau at Geisenheim, recently, a series of experiments were undertaken to determine which, if any, of the ordinary additions to pastes and mucilages for bottle labels prevented fermentation, without injuring the adhesive qualities of the paste. Among the antiferments under observation were salicylic acid, boracic acid, thymol, oil of cloves, etc. Without going into minutiæ, it was found that dextrin, impregnated with from 0·3 to 0·5 per cent. of thymol, produced a paste that has thus far proved all that could be desired.

An Ointment for Chapped Hands.—The Lyon Medical for March 10 publishes the following formula:

Menthol	15 parts.
Salol	30 "
Olive oil	225 "
Lanolin	675 "

To Thaw Out Frozen Water Pipes.—Place unslaked lime around the pipe; cover with straw, and then pour on water. The heat generated by the slaking of the lime will thaw out the pipe if the operation is properly carried out. Pipes may also be protected from freezing by first wrapping with straw, then putting on a layer of unslaked lime, and finally again covering with straw. The gradual slaking of the lime by the moisture of the atmosphere evolves sufficient heat (Neust. Erf. und Erf.) to prevent water pipes from freezing for a whole season.

Alloy for Electrical Purposes.—L'Energie Electrique gives a formula for an alloy which, on account of its coefficient of expansion being the same as that of glass, should be well adapted for incandescent lamps. The alloy consists of 25 parts of zinc and 5 parts of copper, which can be made hard or soft by the addition of 5 to 1 per cent. of lead or zinc respectively.

Dressings for Russet Leather.—

1.	Soft soap	2 parts.
	Linseed oil	3 "
	Annatto solution (in oil)	8 "
	Beeswax	3 "
	Turpentine	8 "
	Water	8 "

Dissolve the soap in the water and add the annatto; melt the wax in the oil and turpentine, and gradually stir in the soap solution, stirring until cold.

2.	Palm oil	16 parts.
	Common soap	48 "
	Oleic acid	32 "
	Glycerin	10 "
	Tannic acid	1 "

Melt the soap and palm oil together at a gentle heat, and add the oleic acid; dissolve the tannic acid in the glycerin, add to the hot soap and oil mixture, and stir until cold.

3.	Oil turpentine	20 parts.
	Yellow wax	9 "
	Common soap	1 "
	Boiling water	20 "

Dissolve the wax in the oil with the aid of the water bath, and the soap in the water; mix the two solutions in a hot mortar, and stir until cold.—American Druggist.

An Acid Proof Glue.—The following has been recommended (Jour. de Pharm. et de Chim.) as producing a cement which will fasten glass or porcelain, etc., together firmly, and will not be affected by strong acids: Mix together 2 parts of powdered asbestos, 1 part of barium sulphate and 2 parts of sodium silicate of 50 degrees Baume strength. A still firmer glue can be made which is particularly valuable, since it is not attacked by hot acids, by mixing together 2 parts of sodium silicate, 1 part of the finest sand and 1 part of finely pulverized asbestos. If potassium silicate is used instead of the sodium salt, the glue will harden immediately, but otherwise it will require about an hour to set.

Peerless Clothes Cleaner.—This compound is used by tailors for renovating and cleaning garments:

Soap bark, ground	4 ounces.
Borax in powder	4 "
Ivory (or other white) soap	4 "
Wood alcohol	1 pint.
Ammonia water	1 "
Boiling water	6 "

Shave the soap fine and dissolve it in the boiling water. Pour the solution at once upon the soap bark and borax in a well tinned or porcelain vessel, stir them thoroughly and let stand half a day, stirring occasionally. Then strain or filter the liquid, adding enough water through the strainer to make 6 pints, and finally add the ammonia water and alcohol; ordinary alcohol will do as well as wood alcohol, but is much more expensive. This is to be applied with a sponge or brush, rubbing into grease or dirt spots, it is then to be washed out with clean warm water. It will make clothes look "as good as new." It can also be used for cleaning fine fabrics, gloves, etc., the only objection being that it wets the goods.

Roach Exterminators.—

POWDERS.

1.	Wheat flour	2 parts.
	Powdered sugar	4 "
	Powdered borax	1 "
	Unslaked lime	1 "

Keep dry.

2.	Powdered borax	37 parts.
	Starch	9 "
	Cocoa	4 "
3.	Plaster of Paris	2 parts.
	Oatmeal	4 "
	Sugar	1 "
4.	Powdered angelica root	5 parts.
	Essence eucalyptus	1 "

Mix well.

PASTES.

1.	Phosphorus	1 part.
	Warm water (70° C.)	16 "
	Molasses	8 "
	Suet or lard	16 "
	Oatmeal or flour	to make a paste.
2.	Red lead	1 part.
	Indian meal	2 "
	Molasses	to make a paste.

Baking Powder.—

1.	Tartaric acid	8 parts.
	Sodium bicarbonate	9 "
	Rice flour	10 "

Use a teaspoonful to every pound of flour used in the dough.

2.	Tartaric acid	7 parts.
	Sodium bicarbonate	8 "
	Magnesium carbonate	3 "
	Farina	6 "

Rub through a sieve.

3.	Tartaric acid	2 parts.
	Sodium bicarbonate	4 "
	Rice flour	3 "
4.	Tartaric acid	6 parts.
	Sodium carbonate (dry)	8 "
	Magnesium carbonate	2 "
	Powdered turmeric	1 part.
5.	Tartaric acid	2 parts.
	Sodium bicarbonate	3 "
	Powdered starch	3 "
6.	Sodium bicarbonate	4 parts.
	Potassium bitartrate	9 "
	Starch	7 "

The ingredients must be perfectly dry and the mixtures packed tightly into bottles so as to be protected against moisture as much as possible. By "farina," in the above, is meant any cheap farinaceous material—wheat, rice, or sago flours, etc.

NOTICE.

A PREMIUM of $250 is offered by the SCIENTIFIC AMERICAN for the best essay on

THE PROGRESS OF INVENTION DURING THE PAST FIFTY YEARS.

This paper should not exceed in length 2,500 words.

The above mentioned prize of $250 will be awarded for the best essay, and the prize paper will be published in the Special 50th Anniversary Number of the SCIENTIFIC AMERICAN of July 25. A selection of the five next best papers will be published in subsequent issues of the SCIENTIFIC AMERICAN SUPPLEMENT at our regular rates of compensation.

The papers will be submitted for adjudication to a select jury of three, to be named hereafter.

Rejected MSS. will be returned when accompanied by a stamped and addressed envelope.

Each paper should be signed by a fictitious name, and a card bearing the true name and the fictitious name of the author should accompany each paper, but in a separate sealed envelope.

All papers should be received at this office on or before June 20, 1896, addressed to

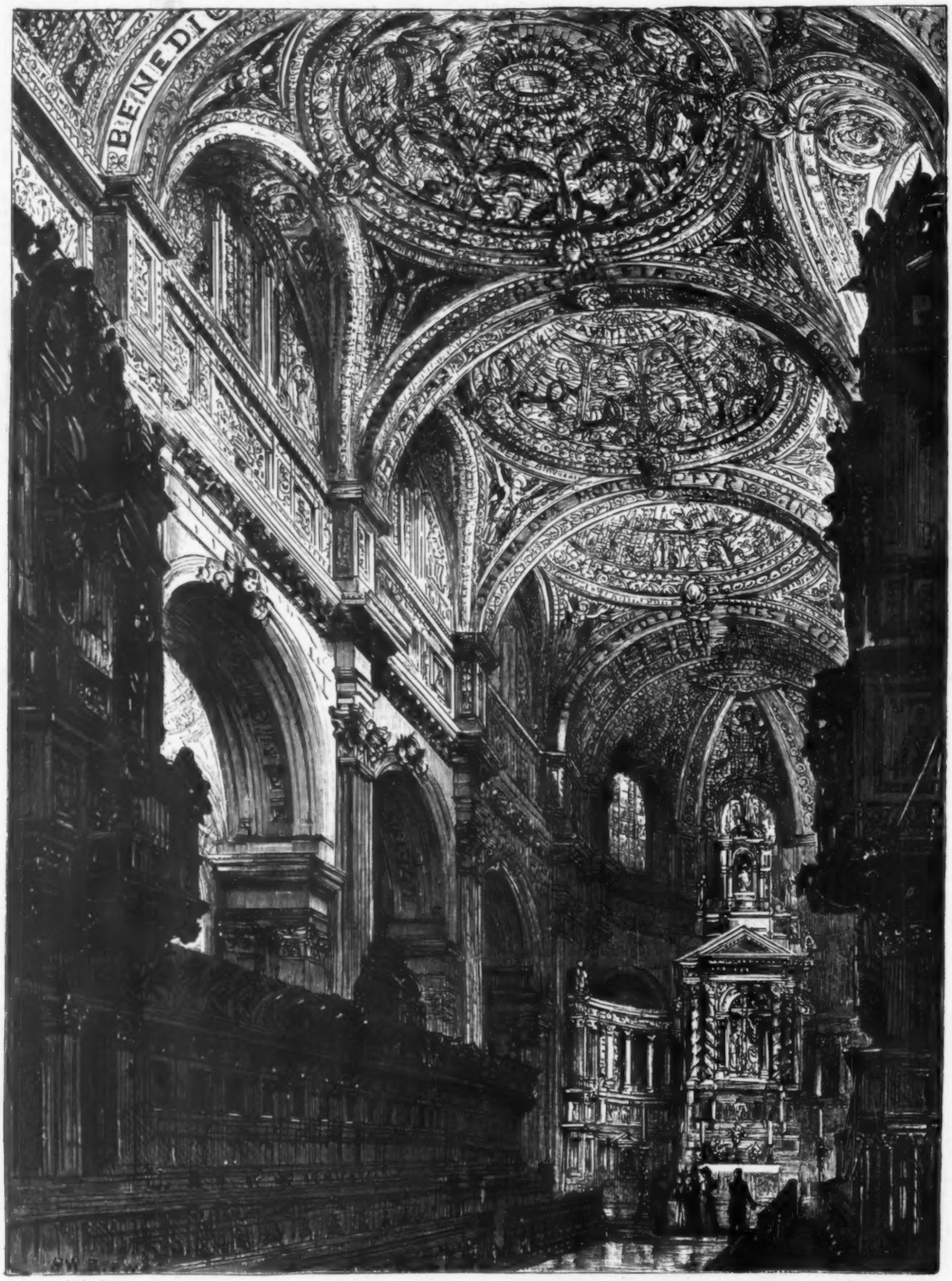
Editor of the SCIENTIFIC AMERICAN,
361 Broadway, New York.

THE MOSAIC DECORATION OF ST. PAUL'S.

MR. RICHMOND, R.A., and his assistants have at length completed the decorations of the choir of the Cathedral of London, and the scaffolding is removed, and with a ceremonial the whole has been thrown open to public inspection. We think that everyone will acknowledge that Mr. Richmond was judicious in the selection of the material for the execution of his designs, and that the choice of mosaic for these decorations was a happy one from every point of view. In the first place durability had to be considered, and nothing can be more durable than mosaic for the carrying out of such adornment. In the next place effectiveness had to be considered, and certainly nothing produces so rich an effect. And in the third place it was absolutely necessary in London to use a material which was capable of being cleaned pretty frequently without injury.

There are several methods of using mosaic. The most ancient is what is called stick mosaic. In this the glass is made into a series of sticks which are broken into small pieces and then stuck into cement upon the walls. A second kind of mosaic is composed of glass in small panes, the pattern or figure being painted on the inside of the glass. This kind of mosaic is to be found in several of our old English cathedrals, notably in the Chapter House, at Canterbury, and was common all over Europe during the fourteenth and fifteenth centuries. A third kind of mosaic consists of small "tesseræ" of tile, stone or marble cut to a certain shape and fitted together. A fine specimen of this is to be seen on the floor of the sacrarium at Westminster Abbey. It is of Italian workmanship. In later times it became the practice, by using extremely small "tesseræ," to make imitations of frescoes and oil paintings in mosaic, and we find this sort of work in plaques and tables, etc., executed in Florence and in the pictures over the altars at St. Peter's, Rome. At St. Paul's Mr. Richmond has confined himself entirely to the first of these processes.

At first it would seem that this was a matter of course, but on the contrary it was one that required great consideration. Two difficulties especially presented themselves. In the first place, this early style of stick mosaic had never been previously used in a church erected in the style of St. Paul's, and in the second place Wren, or those who acted as his assistants, in designing the vaulting of St. Paul's Cathedral, had cut up the spaces by Renaissance mouldings, cornices, cartouches, wreaths, etc., in such a manner as to make it extremely difficult to apply the kind of decoration



THE MOSAIC DECORATIONS OF THE CHOIR OF ST. PAUL'S CATHEDRAL.—DRAWN BY H. W. BREWER.

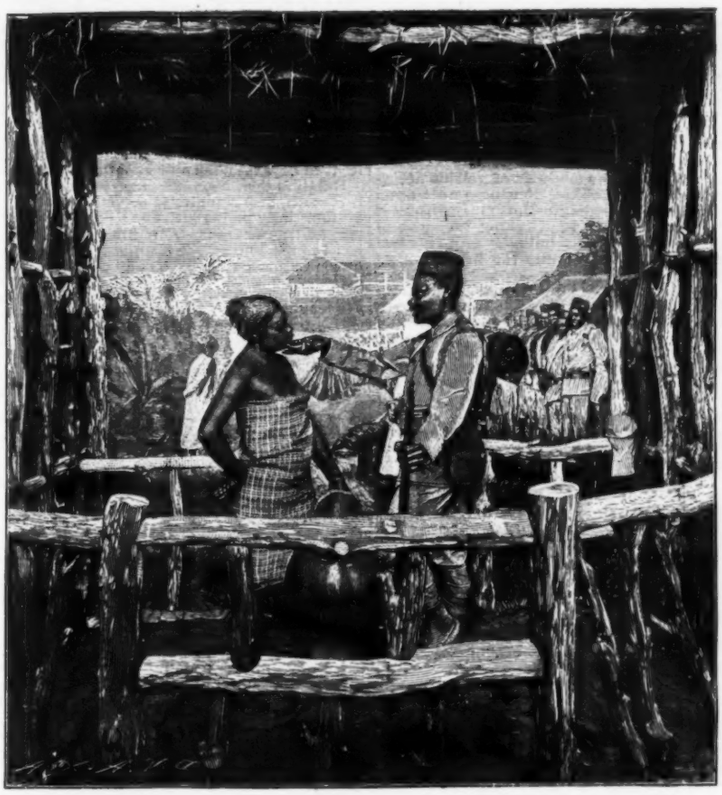
appropriate for such material without removing some of these features, but very properly it was thought inadvisable to make any alterations. No one, except those who have drawn out the shapes of the panels, can conceive the difficulty of filling them with decoration. Another great difficulty in making decorations in St. Paul's look thoroughly satisfactory is the want of light in the building, and we cannot help thinking that it would have been better from the first to have avoided the introduction of stained glass. When all these difficulties are taken into consideration, Mr. Richmond must be heartily congratulated upon the success which he has achieved.

The general scheme consists of a "Majesty" over the center compartment of the apse with attendant spirits. The three domes over the choir represent the Creation. To the east the birds with the words "Omnes volucres cœli" round the arch. The second dome represents the fish and monsters of the deep and is inscribed "Omnia quæ moventur in aquis," and round the dome itself, "Creavit Deus cete grandia" (God created the great whales). The third dome represents the creation of the beasts and is inscribed "Omnes bestiæ et pecora," and over the dome, "Producat terra animam veventem." Over the first arch of the choir are the words, "Benedicite omnia opera Domini Domino," and, of course, the words "Benedicite Domino" are understood after each of the other sentences, so that the whole form an illustration of the canticle "All ye works of the Lord, bless the Lord." The sides of the clearstory windows on the north side represent the appearance of Our Lord to Abraham, Job and his Friends, Moses receiving the Law, Jacob's Vision, etc., and on the south side are the builders of the Temple and the Tabernacle, David, Solomon and the Sibyls. All these subjects are inscribed with passages taken either from the Scriptures or ancient Latin hymns. The stained glass in the windows is all designed to fall in with the general scheme of the decoration.—The London Graphic.

THE NEW CITY MUSEUM IN BREMEN.

ON January 15 last a museum was opened in Bremen, in the erection of which about $297,500 was spent. The arrangement of this museum is quite different from that of other institutions of the kind, for it is not intended as much for the learned as for those not especially familiar with the subjects covered by its exhibits, the desire being to teach as well as amuse them. It is well known that the average visitor at a museum receives comparatively little benefit from what he sees, for he sees without understanding, but here an attempt has been made to bring all subjects within his comprehension by the use of cards, photographs, models, large paintings, plaster casts, etc. In the natural history department, in addition to the aids mentioned above, the microscope is much used and there are also aquariums in connection with the fisheries exhibition. The exhibits cover a great variety of subjects, among which are zoology, comparative anatomy, anthropology, mineralogy and geology, and everything is done to encourage visitors to follow up any subjects in which they are interested and make an intelligent and thorough study of them.

To give an idea of the exhibits in the museum, we publish herewith engravings (for which we are indebted to the Illustrirte Zeitung) of two groups, one of which is intended to illustrate an incident in the life of a German state in East Africa. In the foreground, in a native hut, a Soudanese dressed in the uniform of the German colonial troops is taking leave of a negro girl of the coast type, who has put down her kalabasse, used for carrying water; while in the background we see the German station Moschi, with Kilima-Najaro in the distance. Troops stand ready to march. In the other group the painted background represents a typical Mexican plateau with the snow capped mountains Popocatepetl and Iztaccihuatl in the distance. At the left is an exact although reduced model of the ruins of the pyramid at Xochicalco, and at the right a native hut, from which a mestizo has come to offer refreshment to a man riding on horseback and clad in the national costume. Characteristic plants, cacti, agave, etc., complete the picture.



FROM THE GERMAN STATION MOSCHI—KILIMA-NAJARO IN THE BACKGROUND.

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

By LOUIS A. FERGUSON.

IN a paper read before the National Electric Light Association in this city, on the fifth instant, the following interesting resume of the latest that has been done in the production of calcium carbide was given. Mr. Ferguson described a visit he made a year ago to Spray, N. C., where calcium carbide, from which acetylene gas is obtained, was being manufactured in considerable quantities by T. L Willson and Maj. Morehead. The plant consisted of a Leffel waterwheel which operated two General Electric 120 kilowatt alternating dynamos. These gave a pressure of 1,000 volts, worked in parallel, and this pressure was reduced by transformers to 100 volts.

The electric furnaces in which the calcium carbide was made were each 3 feet square and 8 feet high. Current was supplied to them by copper cables capable of transmitting 1,000 amperes. The bottom of each furnace was a carbon plate, to which one of the poles was attached. The other pole was attached to six huge carbons, each 4 inches square and 36 inches long, weighing 35 pounds.

The material out of which the calcium carbide was made consisted of Pocahontas coke ground into fine powder and mixed with freshly slaked lime. Theoretically, 100 pounds of calcium carbide required 87½ pounds of lime and 56¼ pounds of carbon, which allowed 37½ pounds of the carbon to combine directly with the lime, while 18¾ pounds passed off up the chimney combined with oxygen as carbon monoxide.

A trial was made May 15, 1895, by Mr. Willson and Maj. Morehead, in the presence of Mr. Ferguson, to determine the cost of the manufacture of calcium car-

MEXICAN GROUP—IN THE BACKGROUND POPOCATEPETL AND IZTACCIHUATL.

bide. There were 800 pounds of lime and 390 pounds of powdered coke taken for this experiment, making altogether 1,190 pounds of material. Of this quantity 180 pounds were unused, leaving 1,010 pounds delivered to the furnace. The test was continued for four hours, the quantity of current used being steady at 1,000 amperes and the pressure nearly constant at 100 volts.

Mr. Ferguson found the temperature of the electric furnace was from 3,500° to 4,000° Centigrade, whereas the temperature of an ordinary smelting furnace is only from 1,200° to 1,500°. At the end of the four hours the weight of calcium carbide produced was 139 pounds, leaving unused 607 pounds. Counting 165 pounds of water used to slake the lime, it took 228 pounds of coke and lime to make 138 pounds of calcium carbide, thus showing an efficiency of 58·4 per cent.

Mr. Ferguson took up the methods of getting acetylene gas from calcium carbide by pouring water upon it. He said Prof. Crafts, of the Boston Institute of Technology, had calculated that, taking the heat of an incandescent electric light bulb as 1, the heat of burning acetylene gas was 3, while the heat of ordinary illuminating water gas was 9.

As to the question of cost of production, concerning which so many contradictory statements have been made, Mr. Ferguson showed that 8·3 pounds of calcium carbide could be produced by one electric horse power in twenty-four hours. The carbons cost six cents a pound, lime cost $5 a ton, and coke $2.50 a ton. The cheapest electrical horse power in the world was that of Niagara, at $20 for each horse power a year of 8,760 hours.

Labor would cost $45 a day, or $4.50 a ton, and the cost of packing $1 a ton, if barrels could be used for this purpose. The total cost by this estimate was $33.85 a ton for calcium carbide at Niagara Falls. But the plant would cost at least $25,000, on which the interest at 6 per cent. would be $1,500, and depreciation at 5 per cent. would amount to $1,250 a year, while taxes would be $10 on $1,000 and insurance $3 on $1,000. These items would add 84 cents to the cost of each ton of calcium carbide, while the lowest rate at which it could be shipped to New York, Chicago or Philadelphia would be $3 a ton, making a total cost in these cities of $37.69 a ton. Moreover, these figures would not apply to a new firm, with agencies and canvassers, but only to a large gas company or similar concern, which would not have to incur such expenses.

Comparing acetylene gas with ordinary water gas, as used in New York, Mr. Ferguson found that a ton of calcium carbide would give 10,500 cubic feet of acetylene. But acetylene gas would give 240 candle power for each five cubic feet consumed, whereas five cubic feet of water gas would only give twenty-five candle power. Acetylene was, therefore, ten times as brilliant as water gas. Comparing candle power with candle power, Mr. Ferguson found ordinary water gas cost 30 cents per 1,000 cubic feet, and an equivalent illuminating quantity of acetylene at the figures previously given would cost 37·7 cents, or 20 per cent. more.

Mr. Ferguson discussed the use of acetylene gas in a liquefied form in iron cylinders only to condemn it. He pointed out that acetylene is useless for reinforcing water gas. He proved that it could not be made as a by-product of electric light stations, because the average cost of a horse power a year, in the best, largest, and most economically controlled electric light station, is $65, which would bring up the cost of calcium carbide to $68.49 a ton.

DIVISION TABLE FOR A PHOTOMETER BAR.

FOR those who have to carry out photometric measurements, the table given below may prove useful. It has been compiled by Major Bagnold, R E., to enable a draughtsman to lay out, by means of a beam compass, a scale for reading off results direct from a photometer bar of any length. In this way a great saving of time is effected when a large number of photometric measurements have to be made.

DIVISION TABLE FOR PHOTOMETER BAR.

Column I. gives ratio of light under measurement to standard light. Column II. gives fraction of whole bar measured from its middle point.

I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.
50	·3761	15·0	·2948	7·0	·2256	3·0	·1340	·80	·0279	·40	·1127
49	·3750	14·5	·2921	6·9	·2242	2·9	·1301	·79	·0295	·39	·1158
48	·3739	14·0	·2892	6·8	·2227	2·8	·1260	·78	·0310	·38	·1189
47	·3727	13·5	·2861	6·7	·2213	2·7	·1217	·77	·0326	·37	·1221
46	·3715	13·0	·2829	6·6	·2198	2·6	·1172	·76	·0342	·36	·1254
45	·3702	12·5	·2795	6·5	·2183	2·5	·1127	·75	·0358	·35	·1287
44	·3689	12·0	·2760	6·4	·2167	2·4	·1078	·74	·0375	·34	·1321
43	·3676	11·5	·2722	6·3	·2151	2·3	·1027	·73	·0391	·33	·1356
42	·3663	11·0	·2682	6·2	·2134	2·2	·0973	·72	·0409	·32	·1391
41	·3649	10·5	·2641	6·1	·2118	2·1	·0916	·71	·0426	·31	·1437
40	·3635	10·0	·2597	6·0	·2101	2·0	·0857	·70	·0444	·30	·1464
39	·3620	9·9	·2588	5·9	·2084	1·9	·0795	·69	·0462	·29	·1501
38	·3604	9·8	·2579	5·8	·2066	1·8	·0730	·68	·0480	·28	·1540
37	·3588	9·7	·2570	5·7	·2048	1·7	·0659	·67	·0498	·27	·1578
36	·3571	9·6	·2560	5·6	·2029	1·6	·0582	·66	·0517	·26	·1619
35	·3554	9·5	·2550	5·5	·2010	1·5	·0500	·65	·0536	·25	·1662
34	·3536	9·4	·2540	5·4	·1991	1·4	·0412	·64	·0555	·24	·1707
33	·3517	9·3	·2530	5·3	·1972	1·3	·0317	·63	·0574	·23	·1754
32	·3498	9·2	·2520	5·2	·1952	1·2	·0218	·62	·0594	·22	·1803
31	·3478	9·1	·2510	5·1	·1932	1·1	·0112	·61	·0614	·21	·1854
30	·3457	9·0	·2499	5·0	·1911	1·0	·0000	·60	·0634	·20	·1908
29	·3435	8·9	·2489	4·9	·1889	·99	·0012	·59	·0655	·19	·1964
28	·3413	8·8	·2478	4·8	·1867	·98	·0024	·58	·0676	·18	·2022
27	·3388	8·7	·2467	4·7	·1844	·97	·0037	·57	·0698	·17	·2082
26	·3363	8·6	·2456	4·6	·1821	·96	·0050	·56	·0720	·16	·2144
25	·3335	8·5	·2445	4·5	·1797	·95	·0063	·55	·0742	·15	·2208
24	·3306	8·4	·2424	4·4	·1773	·94	·0076	·54	·0765	·14	·2277
23	·3276	8·3	·2422	4·3	·1748	·93	·0090	·53	·0788	·13	·2349
22	·3243	8·2	·2410	4·2	·1722	·92	·0103	·52	·0811	·12	·2426
21	·3209	8·1	·2399	4·1	·1695	·91	·0117	·51	·0835	·11	·2508
20	·3172	8·0	·2386	4·0	·1667	·90	·0131	·50	·0859	·10	·2597
19·5	·3154	7·9	·2374	3·9	·1639	·89	·0145	·49	·0883	·09	·2692
19·0	·3135	7·8	·2362	3·8	·1609	·88	·0159	·48	·0908	·08	·2794
18·5	·3114	7·7	·2350	3·7	·1579	·87	·0173	·47	·0933	·07	·2905
18·0	·3093	7·6	·2337	3·6	·1547	·86	·0188	·46	·0959	·06	·3032
17·5	·3070	7·5	·2325	3·5	·1516	·85	·0203	·45	·0985	·05	·3174
17·0	·3048	7·4	·2312	3·4	·1483	·84	·0218	·44	·1012	·04	·3332
16·5	·3024	7·3	·2298	3·3	·1450	·83	·0233	·43	·1040	·03	·3538
16·0	·3000	7·2	·2284	3·2	·1415	·82	·0248	·42	·1068	·02	·3791
15·5	·2974	7·1	·2270	3·1	·1379	·81	·0263	·41	·1198	·01	·4091

—Electrical Engineer.

HALATION—WHY IT OCCURS AND HOW TO PREVENT IT.

By T. BOLAS, F.C.S., F.I.C.

THE effect of halation is most noticeable in the case of opaque objects which show against an expanse of sky; as, for example, the spire of a church, the chimneys of a house, or the upper branches of trees. In all these cases there is an effect as of a greater or less fogging over the images of such objects, this being sometimes almost sufficient to obliterate them; indeed, very often the finer branches of trees are completely obliterated.

When halation occurs noticeably, it always mars the photograph; or, to put it in other words, no section or school considers it anything but a disadvantage for all such objects as happen to stand boldly against the light to be weakened and sometimes obliterated.

Halation does not take place to a very noticeable extent with every plate, and, contrary to a prevailing notion, those plates with the thinnest, most structureless, and most transparent films are those least subject to halation, as, for instance, the collodio-albumen films of a former day. When, however, a film is thin, and at the same time granular or coarse in its texture, halation steps in to the very maximum. This can be made clear by the following diagram:

Let A, B, C, D be a glass plate, the thickness of the glass being from A to C or B to D. E, F and G are granular particles of sensitive material, and let us assume that the particle, F, is illuminated, while E and G are shaded. The particle, F, now becomes a radiating source of light, and it will directly radiate upon E and G, and produce upon them the effect of a partial exposure. This action, however, is not halation, it is that irradiation which sometimes troubles the astronomer, and makes the images of his fixed stars larger than they should be, even when a daguerreotype plate is used. Irradiation, or the spreading of the light sideways in the film, as illustrated by the action of the illuminated particle, F, upon the adjacent particles, E and G, is not of any importance whatever to the everyday landscape photographer, as it merely adds a minute and inappreciable fraction to the size of brightly illuminated objects, and detracts to an almost appreciably small degree from the sharpness of outlines between high lights and deep shadows. Halation, as it affects and mars the work of the photographer, is certainly due to the radiation of light from illuminated particles as F, but only to radiation which penetrates the glass plate; some of these rays being then reflected from the back of the glass on to comparatively distant parts of the film.

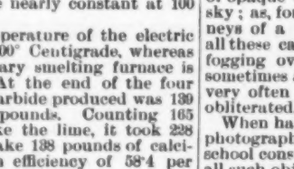


Fig 1

Let rays from F impinge on the back of the glass at all points between C and D. Those impinging between H and I will pass through the back of the glass and in practice will be absorbed by the blackened partition of the dark slide, but those impinging between H and C or between I and D will be reflected, and will strike the back of the film at a considerable distance from the source of the radiation. The length of the line, H I (or rather the diameter of the corresponding circle), where reflection of rays starting from the luminous particle, F, will not take place, will depend on the quality and thickness of the glass; the angle, H F I, being double the critical angle for the kind of glass used.

For such glass as is usually employed, the critical angle is about 40 deg., consequently H F I will be about 80 deg., and it will be obvious that the light radiating from F and reflected between H and any point, C, can only reach the back of those parts of the film which are remote from F by a distance equal to H I; but they will be more or less diffused over other parts of the largest plate. Hence it is that halation due to radiation from the highly illuminated particles corresponding to a brightly lighted sky may to some extent fog the whole of a plate, although the effect is most noticeable in the case of dark objects extending over the strongly illuminated field.

As before mentioned, a thin structureless film is least of all subject to halation, and if a photographic film could be absolutely structureless, no light from the lens could impinge on the back of the plate, so as to be outside the critical angle and within the range of total reflection, even if the lens included the impossible angle of 180 deg. In other words, halation would be a physical impossibility with a perfectly transparent and structureless film. Let us now pass on and consider how the case would stand with a film containing, like the film, E F G, isolated granular particles of sensitive material, but this time a very thick film; so thick, indeed, that there would be several layers of granular particles between the outer surface and the glass; this condition of affairs being indicated by Fig. 2, where we may suppose one particle at F to be

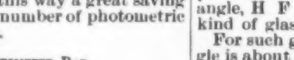


FIG. 2.

strongly illuminated, but this illuminated particle can only affect the adjacent particles, those under it preventing any considerable proportion of the rays from it penetrating to the glass.

A moderately sensitive emulsion is often so torpid and structureless that plates prepared with it have not a very considerable tendency toward halation; but a highly sensitive emulsion is generally so granular in its texture that if plates are thinly coated with it they may be almost useless for outdoor work by reason of tendency to halation; hence it is that not only should highly sensitive plates be more thickly coated than ordinary plates, but with them there is generally more need of taking special means to prevent halation than in the case of plates of low sensitiveness.

In theory there are several methods of preventing halation, but in practice the only important and generally practicable method is to smear the back of the plate with some mixture which will prevent reflection back to the film of any rays which make a new starting point, so to speak, from illuminated particles in the film. The essentials of such a coating are that it should consist of a transparent but nonactinically colored medium, in optical contact with the film; moreover, a medium having a refractive index not much lower than that of the glass. Of all such mediums, caramel or burnt sugar is perhaps the most convenient, and in advocating its use Mr. W. E. Debenham was influenced by such optical considerations as are set forth above.

Caramel may be purchased as a very thick treacle-like substance, and for use it is desirable to give it a more permanent consistency by mixing with it about its own volume of the cheap kind of burnt sienna, which is sold at the oil and color shops, already ground with water. These materials being stirred together, a little methylated spirit is added to thin the mixture, after which a little is dabbed over the back of the plate; a sponge affording a convenient means of doing this. But no more than a slight stipple all over is required, and the extreme edges may be generally neglected. Plates thus backed should be set out on a rack to dry, and about half an hour is sufficient if the rack is placed in a large light-tight box kept for the purpose.

Although the caramel never dries absolutely, the burnt sienna gives it a sufficient consistency if the backed plates are handled with reasonable care. Obviously they must not be piled up face to back, but they may be piled face to face and back to back if ordinary care is taken. After exposure and before development the backing can be quickly and completely removed by means of a moist sponge, as the caramel is never completely dry.

There are several other ways in which the negative image may be weakened or degraded by diffused light, but halation is the commonest and most destructive of all; indeed, there are but few exhibitions where a large proportion of the landscapes do not show its bad effects.—The Amateur Photographer.

THE MEXICAN DRAINAGE CANAL.*

FIFTY years previous to the discovery of America in the year 1492, the king of the Aztecs, named Netzahualcoyotl, saw the necessity for a drainage canal, and commenced the work forty-two years previously (i.e., in 1450); he had constructed an immense dike to divide the fresh from the salt water lakes of the valley. The city of Mexico was at this time the center of the Aztec nation, and was built on floating structures, like rafts, on the water in the numerous islets on the margins of the lakes, so that in the event of the water rising or the city being subjected to a state of siege, the whole city would float. Mexico city now occupies the site where once stood the grand temple of the Aztecs.

The waters of these lakes were liable to disturbances of all kinds; thus it is recorded by Prescott in his "History of the Conquest of Mexico," page 171: "In 1510 the great lake of Texcoco, without the occurrence of a tempest or earthquake, or any other visible cause, became violently agitated, overflowed its banks and, pouring into the streets of Mexico, swept off many of the buildings by the fury of its water."

When Cortes arrived in Mexico from Spain in 1519 to take possession of the country in the name of the king of Spain, he found, to his great surprise, the defense of the city admirably arranged, and an almost enchanting view of flowering islets forming the floating capital. Little towns and villages lay half concealed by the foliage, and from the distance these looked like companies of wild swans riding quietly on the waves.

A scene so new and wonderful filled the rude heart of the Spaniard with amazement. So astonished was he at the extent of the water of Lake Texcoco that he describes it as "a sea that embraces the whole valley," but upon hearing that it was a lake, with a mean depth of a few yards, he gave orders to cut a way through the dike and destroy the aqueduct of Chapultepec. The central dike dividing the fresh from the salt water lake was of such dimensions as to serve Cortes as a roadway for his army.

Prescott, in the work before alluded to, page 297, says: "Leaving the mainland, the Spaniards came on the great dike or causeway, which stretches some four or five miles in length, and divides Lake Chalco from Xochicalco on the west. It was a lance in breadth in the narrowest part, and in some places wide enough for eight horses to ride abreast. It was a solid structure of stone and lime, running directly through the lake, and struck the Spaniards as one of the most remarkable works they had seen in the country."

Having cut the dikes and drained the lake, the "floating city" was at once besieged, and where originally stood the great temple of the Aztecs a Christian temple was afterward raised. The Spaniards, finding themselves in complete possession, proceeded to erect the new city of Mexico, and building on the plan adopted by them at home, they cut down the points of the floating islands, and by gradual extension soon placed the town below the mean average level of the lake. Hence arose the great difficulties of the drainage of the valley of Mexico.

From 1519 to 1553 the Spaniards were busily engaged in building Mexico, and another grand dike, similar to that built by Netzahualcoyotl in 1492, was formed around the city; this protection proved insufficient, for in 1580 another inundation took place. The viceroy of the day, Senor Don Martin Enriquez, assisted by engineers, engaged to find an outlet for the waters north of the valley. During the time they were thus engaged, important facts were gleaned respecting the river Cuautitlan and its curious behavior at the foot of Nochistongo, whence it doubled its course at a certain altitude and ran toward Lake Texcoco, instead of into its own lake of Xaltocan. The scheme formed by

* A paper by Mr. F. H. Cheesewright, read at the meeting of the Society of Arts on February 9, 1896.—In the Architect and Contract Reporter.

Enriquez to remedy this evil was kept in abeyance, as his services were required in Peru.

In the year 1604 a serious inundation attacked Mexico city. The Marquis de Monteselaros did all in his power to carry out the plan of Senor Don Martin Enriquez to relieve the rivers of the north of the valley of the excess of water from the central and south lakes, which are of higher altitudes. The pros and cons of this plan were beset with many great difficulties, and respecting one of the methods tried, mention must be made of a dike of great strength, constructed to prevent any excess, or overflow, of water from destroying the town of Zumpango and washing away its crops. This dike, which was to check the strong current of the river Pachuca, would also direct the river Cuautitlan to Mexico, direct the rivers north into Zumpango, and would inundate that verdant district and probably submerge the town; whereas, to divert them into Lake Texcoco would submerge Mexico. What was to be done? This query was answered by the decision to make a tunnel; but here, as in all countries and in all ages, engineers, when engaged in any work of magnitude, and of a different character from that commonly known, always find theorists to offer objections, and thus stop the way to actual progress. This was the case in Mexico city.

In 1607 another inundation, spreading over the whole valley, occurred, and as all the dikes and other defenses were swept away, caused a panic of terror among the inhabitants. The Marquis de Salinas was then governor of Mexico city, and determined to carry out the plan of Senor Don Martin Enriquez, being assisted by an engineer of great repute named Enrico Martinez, and also solicited and obtained the co-operation of Father Sanchez, of the Society of Jesus. These three men, after many consultations, formulated the plan of embracing the whole of the lakes of the plain into one main channel of detention, and an outlet as required to keep the same under such control as to have at all times an abundance of water for use. The plan, broadly speaking, was to draw off the water from the south lakes which are at higher levels to those of the north and to make them serve, by the scour the velocity of the water would cause, to deepen the passage for their exit and, at the same time, assist the making of the grand canal.

Great opposition to this plan was offered on the score of economy, and many insisted that the inundations were solely due to the waters of Cuautitlan and the freshets of Pachuca, and if these were directed north no more was needed, while the people of Zumpango tried to show that no more was needed to inundate their town and submerge the district. The governor then requested Enrico Martinez to induce Father Sanchez to submit some modifications of his former scheme.

The plan was modified, and on November 28, 1607, Enrico Martinez started operations on the modified plan, and in about eleven months 6 600 meters (4⅛ miles) of canal, with a transverse section of 3·50 meters (11½ ft.) wide and a depth of 4·20 meters (13¾ ft.), was completed. At the same time other important drainage works were being made; the passage was opened from Boca de San Gregorio to Salto de Tula; this was 8,600 meters (5⅓ miles) long, as well as two canals as aqueducts 6¼ miles long, one for Lake Zumpango and the other for the river Cuautitlan from Teoloyucan to Huehuetoca.

In December, 1608, under the presidency of Velasco and the Archbishop of Mexico, Enrico Martinez inaugurated the outlet of the waters, the whole of the work just described being executed in one year. Humboldt tells us that 15,000 native Indians were employed on these works.

In spite of the great good these works brought to the people, there was an outcry for economy, but it is certain that other motives prompted the disturbance and the attempt to harass and hamper the governor. The object was to prevent a grant of money from being made to pay for the lining of the canal with cement. This was found to be necessary, as the greater part of the work was excavated in marl, and the liberated waters ran with such velocity that the symmetry of the tunnel was soon destroyed, and its passage and usefulness lessened by the debris that obstructed the fairway. This state of things was brought so forcibly home to the objectors that a small sum of money was reluctantly granted, sufficient to patch up the tunnel in places where the rush of waters had made the most havoc, hydraulic cement or mortar being used, but the sum granted was proved to be totally inadequate, and for want of more money the tunnel was rendered perfectly useless by falling obstructions. This occurred in the year 1609. Gossips and theorists then united to run down the scheme, although it was conceded that the work had averted a terrible inundation or submergence of Mexico city.

A few years elapsed before the question of continuing the works for the tunnel again caused excitement, but a general feeling grew up that the work of the tunnel should be continued. The opposition was strong enough to obtain the hearing of an appeal in Madrid, with the result that the Spanish government in 1614 procured the services of a Dutch engineer, named Adrian Van Boot, to proceed to Mexico city to examine and report on the canal works and to submit a plan to remedy the evils. As the result of his labors he condemned the plan of Father Sanchez, and recommended that the old means of defense used by the Indians should again be adopted, and that dams and dikes should be thrown up at once. This report had the effect of annoying almost everybody, and was the means of much fruitless discussion. In this dilemma the Spanish government when appealed to confessed they were unable to advise the governor of Mexico what to do, but sent the Marquis of Gelvez to Mexico to see into matters, and he, having unbounded faith in the celebrity of the Dutch engineer, Adrian Van Boot, and hoping to keep money in the treasury, ordered Enrico Martinez to close up the tunnel completely and to return the rivers to their natural courses; but before these orders were half executed the enormous rush of waters grew so alarming that he revoked his own order and issued another to open up the tunnel, and that with all speed, on his personal responsibility. Although the Marquis gave these orders, he forgot to give Martinez the money to carry them out, and, as a consequence, the works remained in a deplorable condition.

By order of the Marquis de Gelvez, Enrico Martinez was cast into prison for "having closed the mouth of the tunnel as a means of proving the superiority of his plan over that of Adrian Van Boot." The marquis was soon after deposed, his place being taken by the Marquis de Ceralvo, whose first act was to set Martinez free at the request of the city council, who provided him with the means of continuing his work on the canal and tunnel.

Evaporation is so excessive at certain periods of the year that malaria, consequent on drought, was far more dreaded by the inhabitants than the periodical floods, and thousands perished annually, so that proper drainage was an absolute necessity for the preservation of health.

On June 20, 1629, the ever troublesome river Cuautitlan overflowed and inundated the north of the plain, and swept with it other streams into Lake Texcoco. In the September following the increase of the water was greater than ever had been known. The city was so suddenly and completely submerged that 30,000 persons perished, the bodies floating about the streets for some time after. The destruction of property and life, consequent on the inundation, was so great generally, and affected the tunnel to such an extent, that during a period of five years there was scarcely any reduction in the height of the water, and the water in the city remained during all this time as high as the second story of the houses; the slight difference in height of the water was caused by evaporation.

The Spanish government at Madrid gave orders to change the capital to a better and more secure site. To this suggestion the citizens demurred, saying, in effect, that to insure complete security an outlay of only $3,000,000 (600,000l.) was necessary, this being the estimated cost of completing the tunnel, whereas to build a new city would involve an outlay of $50,000,000 (10,000 000l.), with a loss of another $50,000,000 (10,000,000l.) in leaving the old one.

Several plans were now submitted in opposition to that of Enrico Martinez, and one by Simon Mendez was accepted, his plan being to direct all the waters of the valley by one canal into the neck of the Tiila, the spot selected by Martinez for his outlet. It was soon discovered that the plan of Simon Mendez was far too costly, and as the money that could be spared was practically melting away without perceptible progress being made, Enrico Martinez was again requested to carry out the work as arranged with Father Sanchez.

The next governor, the Marquis de Cadereyta, was most desirous to see the work of the tunnel pushed on; but however enthusiastic he may have been, lack of funds prevented him from giving effect to his desires. The work continued very slowly, Martinez being unable to do any work at the tunnel, and he contented himself by improving the canal by lining it in bad places with cement. Poor Martinez struggled on for thirty-seven years with this work, and died unnoticed and uncared for. His burial place is unknown.

In 1637 an earthquake made sad havoc with the tunnel works, and for lack of funds no repairs could take place; but when funds were obtainable workmen could not be got, the earthquakes and inundations having carried off many thousands of these poor fellows. The survivors lacked heart to return to such an unfortunate and, as they thought, accursed work.

In the year 1640 the work was being pressed on by men from the prisons, under the direction of the Franciscan monks, and carried on, with varying results, in this way for thirty-five years, until Senor Martin Solis was made head of the municipal council. He being an avowed enemy to the Franciscans, sent them away, and undertook the superintendence of the work himself; but his method of treating the prisoners was so harsh and cruel that they broke out into open revolt, and the works were threatened. Therefore, to save the works and his own life, he consented to the return of the Franciscans. It is estimated that up to this time some 200,000 men lost their lives on this work. The Franciscans steadily, but slowly, worked on, always with a very limited exchequer, until 1767, when there remained some 1,935 meters (1⅛ miles) still to be completed. A contract was entered into to finish this work in five years for $800,000 (160,000l.); but instead of five years it took twenty-two years, and instead of 8 meters (25 feet) wide, as contracted for, it was only 3 meters (9 feet 10 inches) wide.

From the foregoing it will be easily understood that the expenditure on these canal works was a great drain on the Mexican treasury. Up to the year 1637, $3,000,000 (600,000l.) had been expended; between that year and 1800, $3,247,670 (649,534l.) had been absorbed, and up to 1830 the total expenditure was $8,000,000 (1,600,000l.)

In 1849 Capt. Smith, of the Corps of American Engineers, who came to Mexico with General Scott's army, adopted the plan, with slight modifications, designed by Simon Mendez. The tunnel was planned through the ravine of Acatlan, its mouth being near the village of Tequizuiac.

In 1886 a project proposed by Senor Francisco Garray, a Mexican engineer of repute, was pronounced the most feasible, and adopted, but revolution succeeded revolution, causing the works to be stopped for some years. In 1879 Don Luis Espinosa took charge of the undertaking, and has continued to direct affairs until the present time.

The present gigantic work cannot have been considered to have been seriously undertaken, with a view of completion at any cost, until the year 1885, when the city council of Mexico submitted a project to the government to which they offered to contribute largely in the event of its being adopted.

A special commission, with ample authority to deal with the funds set aside for the work, was appointed by President Porforio Diaz. The city council set aside the sum of $400,000 (66 666l.) per annum for the canal works, which sum was materially increased by the Federal government.

In 1887 the city council raised a loan in London of 2,400,000l. to meet the cost of the work and guarantee its successful termination. The entire responsibility of the work was now assumed by the city council, and the government gave authority for the council to make and collect new taxes. Still, there was not sufficient money forthcoming, so another loan was raised in London for 3,000,000l.

In December, 1889, the Department of Public Works contracted with Messrs. S. Pearson & Son, of London, for the completion of the canal, the excavation for which was originally contracted for by the Bucyrus Company, of the United States, of which Col. Ellis was the president. This company started with two spoon dredgers capable of raising a maximum of 1,000 cubic meters (1,308 cubic yards) per day the work of dredging alone, as there were some 16,000,000 of cubic meters (20,928,000 cubic yards) of excavation to do, would take about forty-three years; their contract was therefore canceled, and another entered into with Messrs. S. Pearson & Son, as stated above, who have completed the canal to the satisfaction of all concerned in six years. Too much praise cannot be given to this firm for the way in which the work has been done by them, the best of relations existing at all times between the parties concerned representing the Federal government and the contractors. Five large dredgers were used on the work, and by these means excavations to the depth of 20 meters (65 feet) were made, and the earth was raised to an elevation of 16 meters (52½ feet), so as to empty it into the shoots, ultimately delivering it on to the banks on either side of the canal. These dredgers have now done their work here, three of the five having already been taken to pieces, packed and partially transferred to the harbor works at Vera Cruz, while the other two were being dismantled when I visited the country in July last.

The contract for completing the tunnel was let to Messrs. Reid & Campbell, of Mexico, but for some reason they were unable to carry out the work. It was therefore continued and satisfactorily completed by the city council by their own men at their own cost, for a sum considerably less than Messrs. Reid & Campbell's contract price.

The tunnel has a length of 10,021·79 meters, or 32,869 feet (6¼ miles), with a curved section formed by four curves respectively of the following dimensions. The upper part has a span of 4·185 meters, or 13 feet 9 inches, and a rise of 1·570 meters, or 5 feet 1½ inches; the two lateral arches have a chord each of 2·36 meters, or 7 feet 9 inches, a radius with a chord of 2·429 meters, or 8 feet, and a rise of 0·521 meter, or 1 foot 8½ inches; the elevation is 4·286 meters, or 14 feet, and the greatest width is the span of the upper arch. The tunnel is lined with brick, having a thickness in the upper of 0·45 meter, or 1 foot 6 inches, and in the lower part, over which the water runs, of 0·40 meter, or 1 foot 4 inches in the side arches, and of 0·30 meter, or 1 foot in the radius, this latter lining being of artificial stone, made of sand and Portland cement. The elevation of the invert at the beginning of the tunnel is 9·20 meters, or 30 feet 1½ inches below datum; at the end of the tunnel, 17·53 meters, or 57 feet 6 inches below datum. The gradient is 0·00069 for the first 2170·74 meters, or 1 in 1,449 for 7,120 feet; 0·00072 for the following 5,831 meters, or 1 in 1,389 for 19,125 feet 6 inches; 0·001 for 5,100 meters, or 1 in 1,389 for 16,728 feet; and 0·00135, 1 in 740, for the rest of the tunnel, these changes being in accordance with changes of details made from those of the original project, in some cases modifying the section and in other cases the lining. Twenty-five shafts, each 16 feet 6¾ inches by 9 feet 10 inches, were opened at a distance of 400 meters, or 1,312 feet from each other. These served to ventilate the tunnel and to facilitate the work. The deepest of these shafts, situated on the saddle of Acatlan, has a depth of 92 meters, or 301 feet 9 inches; the shallowest is 21 meters, or 68 feet 10 inches.

To give an idea of the labor involved beyond the mere tunneling, it is as well to mention that the quantity of materials required per lineal yard of tunnel was 1,800 bricks, 94 cement blocks, 3 cubic yards of mortar, and 70 cubic feet of volcanic stone.

Maximum discharge through the tunnel = 18 cubic meters (635⅝ cubic feet).

The canal starts from the San Lazaro Station of the Hidalgo Railway, runs on the east side of the Guadalupe mountain range, between this range and Lake Texcoco. It then changes its direction to the northwest, diagonally traversing San Christobal Lake, a part of Joltocan and another of Lake Tampango, where it finishes at the mouth of the tunnel, having a total length of 67½ kilometers, or 43 miles.

The level of the bottom of the canal above the datum line adopted is 2·25 meters, or 7 feet 4 inches, and the mouth of the tunnel is 9·20 meters, or 30 feet ¾ inch below the same datum, supposed to pass 10 meters, or 33·80 feet below the bottom of the Aztec Calendar Stone. The level of the ground at the beginning of the canal is 8·94 meters, or 29 feet 4 inches, and at the end 15·86 meters, or 52 feet above datum. The uniform slope of the canal is at the rate of 0·187 per kilometer.

The canal has a depth at its commencement of 5·50 meters, or 18 feet, which, in the last few kilometers, is increased to 20·50 meters, or 67 feet 3 inches.

The side slopes are projected with a batter of 45°, and the width of the bottom is 5·50 meters, or 18 feet, for the first 20 kilometers, or 12½ miles, and 6·50 meters, or 21 feet 2 inches, in the rest of the canal.

The first 20 kilometers, or 12½ miles, may be considered as a prolongation of the net of sewers in the city, and will receive only the water that passes through them.

The flow is calculated for an average of 5 cubic meters (176½ cubic feet), although when heavy rains require it a greater volume can be received. The rest of the canal communicates with Lake Texcoco, and is utilized in controling its waters—the lowest in the valley—which can be made to flow into the canal from all parts. Hence the canal has been built to carry the largest flow that can pass through the tunnel, or 18 cubic meters (635⅝ cubic feet) per second. The cutting is through a strictly clay formation, comprising occasional thin strata of sand and sandstone.

For accommodation of railroads, wagon roads and watercourses, it was necessary to construct five aqueducts—four of masonry and one of iron—to carry rivers; four iron bridges for the passage of railroads, and fourteen bridges for vehicular traffic.

For a century the problem has been settling into one of pure sanitation. The plans which the government have been working since about 1883, though called plans for draining the valley, are really intended to obtain a fall sufficient to dispose of the sewage; in fact, in

the original plan, from considerations of economy, care was to be taken to keep out of the projected canal all water both from the surface of the valley and from the rivers. The Consulado and Guadalupe rivers were to be carried over the new canals in iron aqueducts. The drainage system was thus to be simply a part of the sewage system of the city.

Sluice gates direct the city drainage either to the canal or to Lake Texcoco. A sluice gate at the junction of the smaller with the larger part of the canal controls the flow of Lake Texcoco, and another sluice is placed at the entrance of the tunnel.

The total cost of the tunnel and canal may be taken as being $56,000,000 (7,000,000l).

When I visited the works in July last there were some hundreds of men preparing what may be termed a sluice chamber, which is to regulate the supply of drainage into the tunnel.

It will be readily understood that the great good that will accrue from this canal cannot be thoroughly appreciated for some time. When the drainage is effected, Mexico city, with its sublime climate, must be the most healthy city in the world, as it was lately the most pestilential one, having the highest death rate of any city.

THE CHAMONIX RAILWAY.

BEFORE adjourning until May 19, the Chamber adopted the project of a law declaring the establishment of a rack railway between Chamonix and the Mer de Glace to be of public utility. This interesting project will soon receive the sanction of the Senate. It will be possible to begin the work by next summer, and, at the beginning of the next century, the twenty thousand tourists who annually make an excursion to the Mer de Glace, and the number of whom will evidently increase, will be able to travel comfortably in cars as far as to the glacier.

The future railway already has a history. The examination to which the preamble presented by Mr. Goss, of Geneva, and his associates was submitted revealed considerable opposition. The examining committee itself concluded upon a rejection of it in laying great stress upon the injury that would be done to guides, the owners of mules and the commune of Chamonix, the proprietor of the Montenvers Hotel, which yields an annual revenue of $5,600. An appeal had to be made to the General Council of Upper Savoy. It was recognized that the establishment of the projected line would permit Chamonix to compete with its Swiss rivals, who have long been provided with analogous railways, and that it would increase the number of visitors to this picturesque region. Finally, an opinion favorable to the declaration of public utility was emitted upon the twofold condition that the granters should demand no subsidy or guarantee of interests, and should agree to neither construct nor operate any hotel that might compete with that of Montenvers.

The origin of the line is upon the left bank of the Arve, at Biolay, in proximity to the station projected by the Paris-Lyons-Mediterranean Company for the terminus of the line from Fayet to Chamonix under construction. The line first descends to the valley of the Arve and then ascends to the village of Barats. At this point the direction line describes a complete semicircle that leads it to the foot of the mountain. Then it climbs the mountain side a little above the nearby route now taken by the mules between Chamonix and the Mer de Glace, and ends at the glacier, at an elevation of 6,300 feet. The terminal station will be situated slightly to the right of the Montenvers Hotel, which is to be seen in our photographic reproduction of the Mer de Glace

The total length of the line is 18,000 feet. The difference in height between the extreme points is 2,900 feet. The mean gradient is therefore two inches to the foot. At certain places the gradient reaches two and a quarter inches to the foot.

The panorama that unrolls before the eyes of the traveler is most beautiful and varied all along the route. The view embraces in succession the entire valley of the Arve from Houches as far as to Argentiere, the rocky mass of Brevent, the Aiguilles Rouges, the neck of Balme, the secondary needles of the Mont Blanc chain from the Giant up to the Aiguille du Four. As for the Mer de Glace, that stretches out in splendor, and we perceive a portion of the three wide glaciers between which it divides at its upper extremity near Tacul—the glacier of Talefre at the northeast, that of Leschaux at the southeast, that of Tacul, or the Giant, at the southwest.

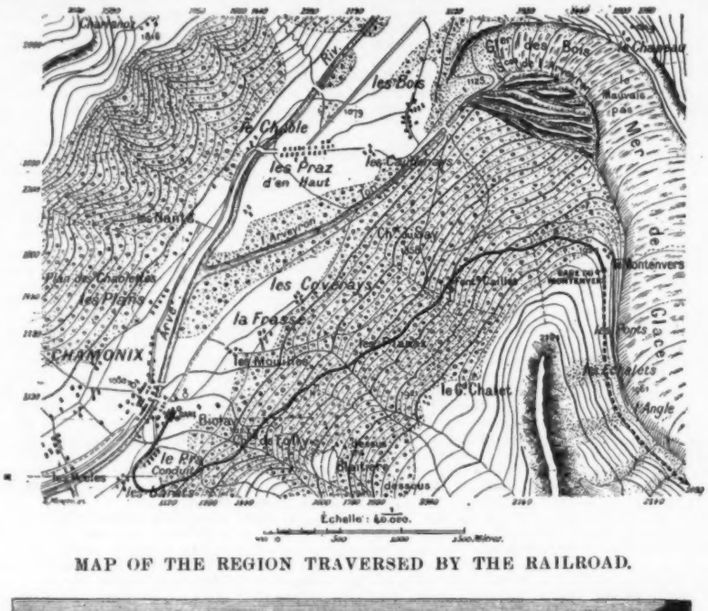
We should add that it is proposed to construct a mule road starting from the Montenvers station and ending at the foot of the glacier of Tacul at an altitude of 8,200 feet. This rocky road, which is shown by dotted lines in our map, will be two and a half miles in length, and from the extreme point it will be possible to take in a general view of the glaciers of Tacul, Leschaux and Talefre, which are finer than the finest of Switzerland. Tourists will thus in a single day be able to make an incomparable excursion.

The gage of the railway between Chamonix and the Mer de Glace will be 3·28 feet. In the first part of the line, up to the foot of the mountain, at the half mile point, the locomotives will act by adhesion upon the rails, and will then ascend upon a rack. They will be so constructed as to haul a car seating from 50 to 60 persons.

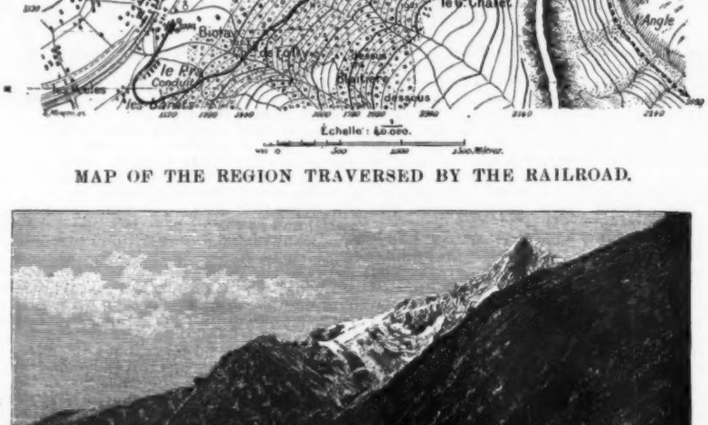
In addition to the terminal stations, there will be established at every thousand feet of elevation way stations for supplies and the shunting of the locomotives. There will thus be two intermediate stopping places.

The project calls for five tunnels of a total length of 1,215 feet, and thirteen bridges of more than ten feet opening, three of which, over the torrents of Blaitiers and Greppen, and the passage of Lanches, will measure sixty-five feet.

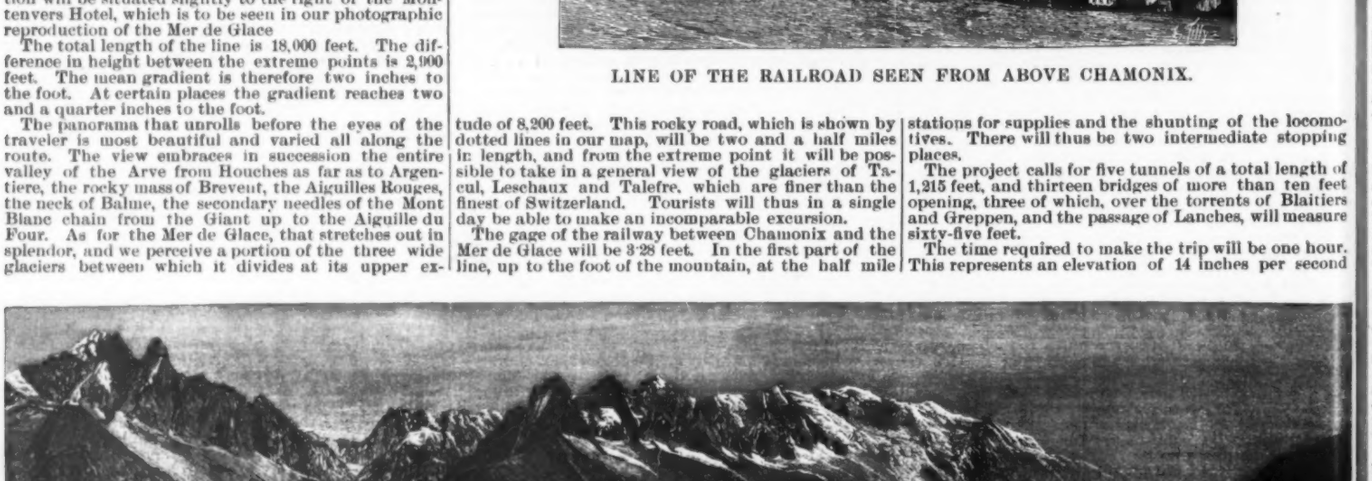
The time required to make the trip will be one hour. This represents an elevation of 14 inches per second



MAP OF THE REGION TRAVERSED BY THE RAILROAD.



LINE OF THE RAILROAD SEEN FROM ABOVE CHAMONIX.



RACK RAILROAD FROM CHAMONIX TO THE MER DE GLACE, SEEN FROM THE BREVENT.

and a speed of 3·6 miles an hour. If the requirements of the traffic demanded, it would be easy to dispatch a train every three-quarters of an hour in each direction. The fare will be $1.60 for the up trip and 80 cents for the down, or $2.20 for the round trip. It is estimated that 15,000 travelers will be carried during the first year, the season lasting from three to four months at the most.

The time of executing the work has been fixed at six years, by reason of the altitude of the region, which scarcely permits of working on the line for more than a hundred days per year, and on account of the broken character of the land, which renders it difficult to carry supplies. But it is honed that the first cars will be able to run between Chamonix and the Mer de Glace by the year 1900.—L'Illustration.

A CHINESE RAILROAD—THE LINE FROM TIENTSIN TO SHAN-HAI-KUAN.*

THE line as at present finished begins at Tientsin. The first important stop is at Tongku, 27 miles from Tientsin and 6 miles from the mouth of the Pei-ho, at the Gulf of Pechihli. Both Tientsin and Tongku are on the Pei-ho, by which waterway steamers reach Tientsin. From Tongku the road swings off to the northeast to Shan-Hai-Kuan—the terminus of the present operated line and the terminus on the Gulf of Pechihli of the Great Wall. Shan-Hai-Kuan is distant from Tongku about 150 miles. Surveys have been made for 200 miles beyond the gap in the Great Wall at Shan-Hai-Kuan, and construction has been completed for a distance of 10 miles.

The line, when finished, will run to Kirin, the center of Manchuria. A branch will also be built to the Gulf of Liao-tung, where there is a good harbor. During the recent war with Japan, work on the road was interrupted and has not yet been resumed.

A trip over this line to Shan-Hai-Kuan presents many points of interest. All the foreigners employed are either English or Scotch; English methods, therefore, largely prevail. The greater part of the line runs through a flat alluvial country, which, during the rainy season, is subject to heavy floods. The location of the line presents no engineering difficulties. The sharpest curve has a radius of 1,000 ft. There is only one of these curves, and it was made necessary, not by the contour of the country, but by the location of two private cemeteries that could not be molested. The majority of the curves have a radius of not less than 3,000 ft. The maximum grade is three-fourths of one per cent.

AN AGRICULTURAL COUNTRY.

The country from Tientsin to Shan-Hai-Kuan contains no large towns or cities, but a great number of mud villages. As yet, it is strictly an agricultural country. The staple product is corn, insufficiently produced to support the natives. The Kaiping coal mines, about 80 miles from Tientsin on the road, comprise the only mining industry as yet in operation, although there are deposits of coal, iron, gold and silver awaiting the intelligent application of capital.

The natives are very poor, and it is only by putting the railroad rates down to a mere trifle that they can be induced to travel. To give an idea of the condition of the people, I would state that at and around Tongshan, the center of the operated line, and the location of the Kaiping coal mines, it has been estimated that about 50,000 natives died of starvation during the months of March and April of this year.

The trains are all "mixed"—freight and passenger. From Tientsin to Tongku there are four trains each way daily, and from Tongku to Shan-Hai-Kuan there is one train each way daily. The trains are not all heavy, and, in speed, average 15 miles per hour. The road usually pays its running expenses, but as yet has yielded no interest on the first cost of construction and equipment. I have been unable to ascertain the cost of construction.

BUILT ON ENGLISH MODELS.

The building of the road, with its entire equipment, has been done with the English idea of permanency and without regard to first cost or the work required of it. No wooden structures are seen from one end of the line to the other. Stone, brick, concrete or steel are the materials used. The road is a standard gage, and its bed is somewhat wider than in our country. On the subgrade there are 12 or 15 inches of stone ballast, all of which is broken by hand. The company has at Shan-Hai-Kuan one small Blake crusher with which it is experimenting, but owing to the cheapness of coolie labor it is doubtful if steam crushers will pay. The rails used are steel, 60 pounds to the yard, Sandberg pattern. They were made at Barrow, England, or by Blockow & Vaughn, and were delivered at Takee for less than $21 per ton, or at a price that cannot be touched by any of our firms. The only profit received by the English firms was due to a fortunate rate of exchange at the time of delivery. The wooden ties are 8 ft. long by 6 × 9 in. They are spaced 28 in. center to center. Most of them come from Japan, some from Oregon, and a few from Vladivostok. They cost, laid, about 72 cents (Mexican) each.

Owing to the immense rainfall and to the limited time in which it falls, unusually large flood openings are necessary. In going over the line during the dry season, one looks with surprise at these openings in the grading, but in some cases they are not yet sufficiently large. Last year 14 inches of rain fell in six hours at Shan-Hai-Kuan. During the rainy season of four months the total rainfall is usually about 140 inches.

The soil is alluvial deposit, and varies in depth from 20 to 60 ft. The masonry on the line is all first-class cut stone, laid in English Portland cement. The cost of this cement here is about 75 cents less per barrel than in the United States. The foundations for the piers, abutments, etc., are carried down to solid rock. The deeper foundations are laid by means of wrought iron caissons, sunk by the pneumatic process, and then filled with Portland cement concrete. This system of foundations works well here, and the natives take kindly to it as "sinkers." The lengths of the spans used vary from 20 to 200 ft. The majority, however, are short and are deck girders. The head room, under the girders, is from 7 to 16 ft.

* United States Consular Report.

THE LAN-HO BRIDGE.

All of the bridge work is riveted, with the exception of the Lan-ho bridge, which is looked upon here as an engineering wonder. This bridge consists of two roadway spans of 30 ft. each, ten spans of 100 ft. each and five spans of 200 ft. each. The total distance between the faces of the abutments is 2,170 ft. The 200 ft. spans are pin connected, and are always spoken of as being of the American type. The design was made in England under the supervision of Sir Benjamin Baker, and may properly be described as of the American type with English details. The result is curious, and, to a certain extent, incongruous. The form of truss is the ordinary Pratt. The hip verticals are stiff members and nearly as heavy as the first parts. The lower chord is composed of one-half inch steel plates 12 or 15 inches wide. They are spaced on the outside and inside of the posts. The ends are re-enforced by plates riveted on each side in order to give sufficient bearing surface for the pins. The diagonal web members, both main and counters, are broad, thin plates with the ends strengthened by re-enforcing plates. These diagonal members are riveted together where they cross. A light 2 inch angle iron runs the whole length of the truss, and is riveted to the intersection of the diagonals and to each post.

The lateral bracing is one of the most peculiar features of the design. The floor beams are heavy, well designed, and riveted to the inside of the posts. The tops of the posts are connected by stiff members at right angles to the trusses. The lateral diagonals, both top and bottom, do not start from the panel points, but from points halfway between the posts. They are riveted to the chords and intersect opposite the panel points, where they are riveted to the floor beam in the lower system and to the brace between the posts in the top system. The bottom chord is latticed and stiffened in the center of each panel where the lateral diagonals are riveted to it.

What the advantages of this peculiar lateral system may be I am unable to understand, and the cross strain that it will bring to bear upon the chords at their center panel points appears to me to constitute a very grave defect. There is this to be said, however, in regard to the actual safety of this particular bridge. The spans are only 200 feet. The train load used in the designing is many times heavier than the bridge will ever be called upon to bear, and the allowable strain, per unit of area, was small. Therefore, notwithstanding the peculiarity in some of the details, the bridge has undoubtedly a very large "factor of safety." There were eight proposals received for this bridge, one only being American.

At present the shop facilities at Shan-Hai-Kuan are such that all girder work up to 100 feet is done by the railroad company. In order to prevent scouring, many of the waterways are smoothly paved with large concrete blocks, the concrete being, in many cases, cheaper than stone. The dimensions of these blocks are about 3 by 1½ feet by 1 foot thick and their composition one part English Portland cement to sixteen parts of coarse river gravel and sand.

Just before reaching Shan-Hai-Kuan, the line runs across a flat valley about one mile wide. This valley has considerable fall at right angles to the track. During the dry season, a small and insignificant looking stream meanders down this valley and passes under a bridge having an opening of over 1,000 feet. The roadbed was 8 or 10 feet above the bottom of the valley. Last year the river rose 16 feet above the ordinary high water mark, and for six or eight hours the whole valley was filled with a torrent that swept everything before it. When the water fell so that repairs could be made, no attempt was made to rebuild the embankment. The track was lowered to the natural surface of the valley so as to offer no obstruction to any future floods.

To protect the roadbed, a width of 50 feet on each side was carefully paved one foot below the natural surface. The earth was filled back and the space planted with bushes. As the high water only lasts a few hours at a time, and the amount of traffic is small, such an expedient is allowable.

The cost of timber is so great that wooden trestles are out of the question. The station houses are all built of light, burned brick, plastered on the outside. The broad platforms are of stone or concrete filled in with earth and cinders.

SHOPS.

The main shops are at Tong-shan, and consist of shops for the repairing of cars and locomotives and for the construction of rolling stock. At present about 500 men are employed at Tong-shan, but when the shops are run to their full capacity there are 900 names upon the pay roll.

The company builds all of its passenger and freight cars, and also the tenders to locomotives. The sides and roofs of the cars are of Oregon pine, and the framing timbers are of teak. The under framing of both cars and tenders is of mild steel.

These shops are directed by Mr. Churchward, who has been in charge for eight years and thoroughly understands the needs of the road.

The locomotives are all English and Scotch, with the exception of one American engine built by the Grant Locomotive Company. The engines are of the Mogul type. They are fitted with powerful steam brakes on the drivers. The greater part of the freight cars are open, with fixed sides about 4 feet high. There are a few box cars with steel frames covered with thin plates. All cars have two 4 wheel trucks. The truck frames are of iron, excellently designed and made by the company.

American cast iron wheels have been tried, but did not give such satisfactory results as steel tire wheels from Europe.

The passenger cars are of an inferior quality as regards comfort, but they are superior to the treatment they get from the natives. Every car has a brake at each end worked by a screw. As yet, no continuous brakes are used, although two trains were once fitted out with the Westinghouse brake. Owing to some trouble, the directors failed to adopt the system.

There is one detail of the rolling stock that is American—all cars have the Janney coupler. It is a source of regret to the general manager that he cannot manufacture this indispensable article, but must pay the American price for it.

WAGES.

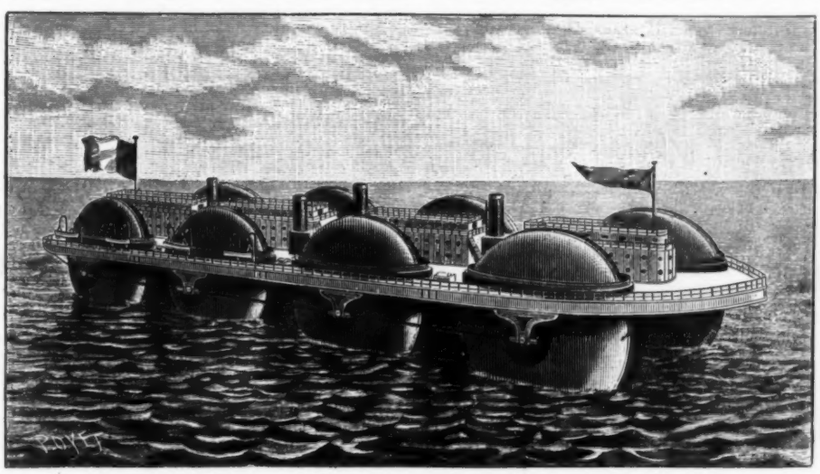
Foreigners, of course, get much more than natives, but not more than the same class of men receive at home. Most of the engine drivers and machinists are natives, and they do good work. A common laborer gets $4 (Mexican) per month; firemen, $5 to $6; engine drivers, $14 to $15. At present, the two highest paid native drivers on the road get $41 and $46 respectively. An English driver can get, as maximum wages, $200 (Mexican) per month; a section hand gets $4; a foreman, $6; a native clerk, $80, if he can speak and write both English and Chinese.

All the work possible is piecework. The trains are run by the English staff system, and only one train is allowed in a block.

At present all construction is at a standstill; nothing is being done except to keep the few trains necessary running. What the future policy will be as regards railroads no one can tell. Certain lines will eventually be built. The Chinese government already sees the necessity of connecting Pekin with the Yangtze Valley. Prejudice, lack of funds, internal dissension and jealousies between viceroys are some of the factors that have to be dealt with before we can set on foot any organized system for the further construction of railroads. At present, the outlook is gloomy, but there are rifts in the political clouds, and, in time, the sun of prosperity and progress may break through.

SHERIDAN P. READ, Consul.

Tientsin, August 28, 1895.



THE BAZIN ROLLER BOAT.—FROM A MODEL ON A SMALL SCALE.

THE BAZIN ROLLER BOAT.

IT is said that the dock yards of Saint Denis in the port of the Seine are busy with the construction of a roller boat of the Bazin system. This vessel, about which much has recently been said, is designed to roll over the water.

Our engraving represents a model of the boat that has been constructed under Mr. Bazin's direction.

The roller boat consists essentially of a platform supported by huge hollow floats or wheels that hold it about 20 ft. above the water. The steel shafts, 32 inches in diameter, that transmit the rotary motion to the wheels, pass beneath and across the platform and run in strong bearings. Upon the platform are situated the engine and furnace rooms, the passenger cabins and the quarters for the various services. One or two screws will give an impulsion to the vessel, which, started in the direction to be taken, will literally roll over the water with but little friction.

It is Mr. Bazin's desire to complete his project by the adjunction of a hydraulic rudder always in action. This rudder consists of a vertical column placed at the stern of the vessel and maneuvered by the pilot. From this column there escapes a powerful stream of water under pressure which operates through action upon the sea. The thrust of this rudder will thus always be utilized, wholly or in part, and will even permit the vessel, upon the roller and propeller engines being stopped, to reach its destination at a speed of a half or a quarter of a knot.—La Nature.

ENGINEERING NOTES.

The laborers on the railways of Northern India have very little strength in their arms, it all being in their legs. A shovel filled with ballast is more than one man cares to manipulate, consequently one man passes the shovel under the ballast and another, by means of a rope attached near the lower end of the handle, drags the load along. This division of labor seems to do very well, and the men will manage to handle a reasonable amount of ballast if given sufficient time. The natives, having no strength in their arms, are not able to pump our handcars, but they can get on the rails behind a car and push it at a speed of ten miles an hour on the level, one man running on each rail.

Mechanical skill of no ordinary character is required to produce the hollow steel boom, the spar which has now become so noted in marine architecture, advantage being gained in exigencies by beginning in the center and riveting the plates toward both ends. In the most recent instance of this construction there were four lines of angle iron braces at equal distances from each other and running the whole length of the boom, giving it a good bracing, the face to the angles being slightly curved to take the concave shape of the interior of the boom, these angles consisting of sections measuring on an average some fifteen feet, with a lap made at each joint one and a half inches in length and bolted with steel. These laps are irregular, in order that two joints or more may not be opposite each other and thus cause weakness.

The Brooklyn Bridge Trustees have given permission to the Reno Inclined Elevated Car Company to erect an experimental moving staircase on the New York terminal of the Brooklyn Bridge. It consists of two parts; the first of these is an endless band which travels around two drums. One drum is sunk below the level of the lower floor of the bridge, so that the upper face of the endless band, where it leaves the roller in going up, is flush with the floor; the upper roller is similarly placed with relation to the upper floor. The band has slats on it to give the passenger a foothold. An endless rope running over pulleys is provided as a convenient hand rail or support. The whole stands at an angle which is not so steep as that of an ordinary stairway. In operation the rollers and pulleys which carry the band will be moved at an even speed, the action will be continuous and all the passengers will have to do is to jump aboard and grasp the hand rope and wait until the belt carries them to the top.

The Aluminum World, in a recent issue, gives the following rules with regard to obtaining the best castings with aluminum bronze, in order to avoid the difficulties which are so frequently met with in melting. An essential point mentioned is the special care to be taken not to overheat the metal, the fact being that, if it be heated to too high a temperature, the aluminum will oxidize, the oxide which is thus formed making the entire casting what artisans term "dirty," and the metal will also be spongy from the presence of large amounts of occluded gases; the scum, too, which floats on top of the melted bronze in the crucible must be prevented from going into the body of the casting, this being practicable by providing the casting with suitable skim gates. The greatest trouble in making bronze casting, however, arises from the shrinkage of the metal, which is very great—a difficulty which is overcome if the casting have a large sinking head and "risers," it being necessary, however, in many cases to make the sinking head fully as large as the casting.

"**Superfusion**" is the term used to indicate a certain kind of crystalline fractures in mild steel, says Engineering Mechanics. Crystals once formed tend to induce neighboring crystals to get the same way, on the principle that evil communications corrupt good manners. While the metal is rigid, however, no action of this kind can take place. But if from any cause the metal in contact with the crystals is strained beyond the elastic limit and enters the plastic state, it is conceivable that the existing crystals may be able to succeed in changing some of their neighbors into the crystalline form. A second repetition of the plastic stage would then cause an extension of the crystallization, which would thus finally extend right across the most severely strained section. Molecules of metal lying either side of this section would not be liable to change, as they would not enter the plastic stage, and thus tests made on specimens taken along the line of fracture should show no loss of ductility. "Local hardening" of the material is the common sense term to describe fracture. But what causes local hardening? Engineers sometimes say the more rigid portion of the material takes more than its share of load beyond the elastic limits. Punching also sometimes starts cracks, but no one understands why they extend into soft parts of the plate.

The inner lake of Bizerta, near Tunis, is connected with the Mediterreanean by a canal 330 ft. wide, 34 ft. deep, not quite a mile long, which is exposed to very heavy currents and winds. Traffic across was originally effected by means of a ferryboat and a guide cable, which was anchored on the one bank and wound round a capstan worked by four men on the other. The ferry now has been replaced by a boat of 68 tons, 50 ft. long, with two engines of 50 horse power each, driving four propellers and two powerful rudders. Further means of communication are, however, needed, and a conveyor bridge of the Anordin and Palacio type has been projected. The only structure of this kind in existence crosses the Nervio Canal, in Spain, 520 ft. wide between Portugalete and Las Arenas. It is a suspension bridge, 148 ft. above high water level, supported by cables from four iron towers, two on each bank. On the bridge moves a traveling table on 36 cast steel rollers drawn by a wire rope. The power comes from a vertical two cylinder engine in the first story, which develops 25 horse power at 300 revolutions; the movement of the traveler does not require more than 5 horse power. The cage or platform is suspended from the traveler by 18 cables, nine on each side, grouped in such a way that one of each three may fall without endangering the cage, and that it cannot swing to and fro with the wind. The cage is held a little above highest water level; it is 26 ft. long, 20 ft. wide and can accommodate 150 persons besides carriages. The plant, which was built by Spanish and French firms, has been working since 1893.

ELECTRICAL NOTES.

Invention says that an electric chaise was ordered by the late Prince Henry of Battenberg for Queen Victoria. The vehicle, which is not yet finished, is built upon a double framework of tubes, with a head tube for steering much as a bicycle has, the steering handle being somewhat like that used in Bath chairs. The body of the carriage is composed of aluminum, and it runs upon three wheels fitted with Michelin tires; the propelling force is a dynamo driven with Fulmen accumulators.

Elster and Geitel, in a communication sent simultaneously to the Philosophical Magazine and to Wiedemann's Annalen, describe experiments which show that the long recognized action of ultra-violet light in discharging the cathode varies according to the polarization of the beam and the angle of incidence upon the cathode. The cathode used was the bright surface of the fluid alloy of potassium and sodium; this being contained in an exhausted tube, and the discharging action as measured by the photo-electric current was greatest when the beam impinged on the metallic surface obliquely rather than normally, and when the plane of polarization of the beam was at right angles to the plane of incidence.

Messrs. Wilson and Gray, in a paper before the Royal Society, give the results of measurements of the temperature of the positive pole of the electric arc. The temperature obtained was 3,600° abs. or 3,300° C. This agrees very closely with the approximate estimate given by Violle (1893), viz., 3,500° C. The method here employed is that used by the same authors in an earlier investigation on the effective temperature of the sun (Phil. Trans., A., vol. clxxxv, 361, 1894). This consisted essentially in balancing the radiation from a platinum strip against that of the carbon of the arc. Further, taking 3,300° as the temperature of the crater of the positive carbon, that of the negative carbon is found to be about 2,400°. No estimate is attempted of the temperature of the arc itself.

The Council of the Society of Arts, London, offer the Fothergill prize of £25 and a silver medal for a paper on "The best means of effectually preventing the leakage of current to earth in electrical installations from generating heat and setting buildings on fire." This paper should consist of about 8,000 words and be written with a view to being read and discussed at an ordinary meeting of the society. Papers submitted for the prize must be sent to the secretary on or before October 1, 1896. Each paper must be typewritten and bear a motto, the name of the writer being inclosed in a sealed envelope with a similar motto. The judges will be appointed by the council. The council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes if, in the opinion of the judges, no essay deserving the full award is sent in.

The belief is widely entertained that cutting the hair frequently strengthens it. But it is also urged by some authorities that the practice is injurious. It is hinted that this is the reason why there are about eighty-five bald men to one bald woman. Those who hold the second of these two opinions say, however, that if, after being cut, the hair is singed, the harm is overcome. Such treatment, it is alleged, stops the escape of oil from the ends of the individual hairs. Various devices have been invented for performing the operation here suggested; and the latest is of an electrical character. A metallic wire is stretched along the teeth of a special comb, close to one side, near the points, and is heated by means of an electric current sent through it by connecting wires. One can regulate the intensity of the current, and therefore the temperature, easily; and the wire also can be adjusted to suit thick or thin hair. With this apparatus, it is claimed, a barber can singe a man's hair in less than a minute. The old process requires ten or fifteen minutes. The new method does better work, too. A small battery accompanies the comb.

One of the most interesting points of Arctic exploration from a scientific point of view, and one to which comparatively little attention seems to have been paid in recent years, is connected with the magnetic pole. The location of the north magnetic pole is an entirely different matter from the pole at the northernmost point of the earth where all our meridians of longitude converge, and fortunately it is not so difficult of access. The point was passed over by the expedition of Sir James Clark Rose in 1840–43, when it was found to be rather more than a thousand miles south of the North Pole proper and in about 70° 5' north latitude and 96° 40' west longitude. This is somewhat near Franklin's Bay, and an expedition in 1844 by Capts. Moore and Clark approximately determined it. Why it is that the compass needle should point to this spot instead of directly to the pole proper is one of those things that the scientists do not seem to have positively agreed about, but which the recent great discoveries in electricity may possibly throw some light upon. It is stated, says the Marine Record, that Prof. George Davidson, of San Francisco, is now planning a new expedition to investigate the matter.

Many physicists have doubted the existence in fact of globular lightning, attributing the statements of its existence to some kind of optical delusion, says Electricity. Prof. Righi, of Bologna, however, announces that he has produced it artificially, and that not only has he succeeded in making its motion slow enough to be followed by the eye, but has been able in certain cases to obtain luminous masses which actually remained stationary for sufficient time to be photographed with a shutter operated by hand. Indispensable conditions for the production of this phenomenon are: (1) that the circuit of discharge have large resistance—for this purpose he introduces a column of distilled water into the circuit; (2) that the condenser have very great capacity, since the greater its capacity, the slower the movement; (3) that the gas in which the discharge takes place should be suitably rarefied, since under these conditions the dimensions of the flame increase as well as the possible length of its path. A large Holtz machine with four plates, driven by a hydraulic motor, charging into a Leyden jar battery of 0·75 microfarad capacity, was the apparatus used which gave the best results.

MISCELLANEOUS NOTES.

The deepest well on the Atlantic coast is said to be at the silk works near Northampton, Mass.; depth, 3,700 ft.

The Ostasiatische Lloyd says that the Japanese government has ordered in Switzerland 18,000 watches at $2.50 each, which are to be given to brave soldiers of the last war in place of medals.

Since "Don Quixote" was first published in 1605, 1,324 editions have been printed, of which 528 were Spanish; 304 English; 179 French; 99 Italian; 84 Portuguese; 45 German; 18 Swedish; 9 Polish; 8 Danish; 6 Russian; 5 Greek; 3 Roumanian; 4 Catalonian; 1 Basque; and 1 Latin.

Norway's supply of cod liver oil is rapidly diminishing. Not only are less fish caught, but the livers of those taken are of inferior quality. While in 1893 the yield of oil was 26,813 barrels; in 1894 it was 18,500, and in 1895, 12,680 barrels, with every prospect of smaller harvests in the future.

The news has been received that the English Court of Queen's Bench has declared valid the English patents of the Welsbach Incandescent Light Company, and has issued a perpetual injunction against the infringers. The suit has been watched with great interest, as about 20,000,000 of these lights are in use.

An expert handler of tools is reported to have recently performed one of the most delicate mechanical feats ever known. He is stated to have taken a common sewing needle of medium size, 1¾ in. long, and drilled a hole through its entire length from eye to point, the opening being just large enough to admit the passage of a very fine hair.

The notion that the Sahara is altogether a barren and worthless waste is wide of the truth. In 1892 there were 9,000,000 sheep in the Algerian Sahara alone, besides 2,000,000 goats and 260,000 camels. On the oases there are 1,500,000 date palms, giving dates worth $3,000,000 a year. So that even the desert is worth keeping under control.

A German inventor provides mirrors which will not break. He employs celluloid where glass was heretofore used. A perfectly transparent, well polished celluloid plate receives a quicksilver backing like that of a glass mirror. This backing is in turn protected by another celluloid plate which also mirrors, so that practically a double mirror is furnished, lighter, cheaper and more lasting than glass. No details of the process are at hand.

There are twenty-six cremation associations in active operation in the United States, says the Tribune Almanac. The oldest was organized at Washington, Pa., in 1876, and the two newest are found at New Haven, Conn., and Elizabeth, N. J. (1894). The number of incinerations reported is 3,670. The number incinerated in Europe from 1876 to 1893 was 19,700. The membership of the American associations is about 8,000 and the adherents of the method about 100,000.

The world's record for the greatest number of ems set in one hour on a Mergenthaler linotype was broken recently by B. J. Mensing, a compositor of the Post-Dispatch, at St. Louis, Mo., says the Mining and Scientific Press. In that time he set up 10,685 ems, 585 more than did Green in Chicago, who held the former record. The event was a seven hour contest between Robert Francis, of the Globe-Democrat, and B. J. Mensing for a purse of $200. About $1,000 changed hands on the result. Mensing won the contest, setting 74,100 ems to 65,800 by his opponent, and had ten minutes lost time.

The United States consul in Liége, reporting on the manufacture of handmade Damascus gun barrels in the valley of the Vesdre, in Liége province, says that the industry has increased greatly in recent years. These armes de luxe, as they are called, are made by men working in pairs, each pair in its own little factory. They are paid by the piece, their wages being good, and about 2,000 men are engaged on the work in the valley. The annual production of Damascus barrels in the valley is about 300,000 pairs, of a value of about three and one-half million francs. Of this, the wages alone amount to about two million francs. The principal markets are Great Britain and the United States.

The vast mineral resources of Russia seem to be attracting more and more attention on the Continent, says Industries and Iron. It is now estimated that, within a comparatively short time, no fewer than thirty-one industrial undertakings have been floated in Russia by Belgians alone, representing a capital calculated at one hundred and eighty million rubles. It is exceedingly singular that the great majority of the metallurgical undertakings in Russia have been promoted on Belgian capital, the French appearing little disposed to take advantage of the commercial opportunities offered them, in spite of the political friendship understood to be subsisting between the two countries. The peculiar business methods prevailing in Russia seem to be less obnoxious to our Continental competitors than to ourselves, if we may judge from the popularity of Russia among investors across the Channel.

The production of fans is an important industry in Spain. The American consul-general in Barcelona states that the center of industry is Valencia, where 20,000 workmen are employed in it, while many thousands more in the adjacent villages devote themselves exclusively to mounting fans in their own homes. The woods most commonly used are the pine, beech and olive for ordinary fans, while sandal, birch, ebony and lignum vitæ are obtained for the finer kinds, while the most expensive of all are made of mother-of-pearl and ivory. The ribs are manufactured in Valencia, where also all the designers, painters and lithographers who are employed in producing paper fans and oleographs work. The cotton and silk materials used in the fans are not produced in Valencia, but go from Lyons, St. Etienne and Great Britain. Spanish fans find their way in large quantities all over the world, but they are not able to compete with the Japanese fans, which weigh much less and are less expensive.

RECENT IMPROVEMENTS IN AMERICA AND EUROPE IN THE STORAGE OF ELECTRICITY.*

By HERBERT LLOYD.

DURING the ten or fifteen years covering the period during which storage batteries have been more or less in commercial use, the electricians of this country have been divided into two distinct classes; and two only—those unalterably opposed to their use and the other class firm believers and, one might say, enthusiasts.

In Europe one gets the impression from an acquaintance with electrical engineers—in England, France and Germany, at any rate—that accumulators are considered an essential feature in almost all electrical work. Some engineers are greater advocates than others of the system, but all are apparently believers. When it is borne in mind that the discovery of secondary currents was made in 1801, and even a lead accumulator was made in 1803, it seems strange that it has only been within the last five or six years that a lead accumulator has been proved to be a commercial piece of apparatus.

A really practical storage battery was, of course, made by Planté in 1860, and another step was made in 1881, when Faure and Brush developed the battery plate made by the application of already formed active material. In about 1890 the chloride plate was developed, differing both from the Brush-Faure and Planté. This plate depends for its usefulness on the peculiar and beautiful crystalline structure of the cast material. Although the present state of the art shows more than one excellent form of positive plate, there has nothing yet been produced comparable with a chloride negative plate. Its capacity for weight and ability to withstand both the use and abuse which a battery, to be successful, must withstand, is almost phenomenal. In England and France the companies doing by far the greater portion of the business use no negative but a chloride negative, and in those countries there are no fundamental battery patents in existence to-day.

In England one is impressed not perhaps with the magnitude of the battery installations, but by their number. Private house plants run by gas or gasoline engines are simply abundant. Central station batteries are being installed about as fast as central stations are built, which in England is comparatively slow. In Manchester, London and Belfast, Ireland, very large central station batteries have been installed within the past year.

Electric traction, of course, in England, and on the Continent, is carried out on a very small scale, either trolley or battery traction. In Birmingham, England, a storage battery road has been in operation for some six or seven years, and has been the experimental ground for almost all makers of battery, and the service rendered was, of course, not the most satisfactory. A little over a year ago the chloride syndicate got a contract for the equipment of all the cars of this line with their battery, and with the experience of their allied company in France at their back, they have been entirely successful, giving service satisfactory to the railroad company, and doing the business at a profit to themselves.

In France, the Madeleine and St. Denis road has now been in operation over three years, running some thirty 22 foot cars, double decked, seating between 50 and 60 people. These cars have run up to this time between two and three million car miles, and the company have every prospect of gradually replacing the horse cars in Paris, in the face of the most terrific competition with steam motors, compressed air motors, gas motors, and I do not know how many more. On this road some very good results have been obtained in what they call "recuperation." A very careful test, covering 100 trips, about 11 miles each, gives the following results, according to figures given by M. Sarcia.

The car while descending a 10 per cent. grade could recover 57 per cent. of the energy expended in ascending it; on a 4 per cent. grade a return of 42 per cent. is effected, and on a 2 per cent. grade 23 per cent. On a 1 per cent. grade the recuperation is zero, with a traction coefficient equivalent to 22 pounds per ton. If the traction coefficient could be reduced to 11 pounds per ton, there would be recovered, in utilizable form, according to their experience, 63 per cent. of the energy expended in ascending a 10 per cent. grade, and with that low coefficient of traction 23 per cent. could be recovered down a 1 per cent. grade. If the traction coefficient was zero on the level, the car having no dead resistance, either electrical or mechanical, there would be recoverable on descending a 2 per cent. grade 70 per cent. of useful energy, the efficiency of the battery being in this case 70 per cent. An electric mountain railroad recently built on the Isle of Man, on which the grade is almost a uniform 12 per cent., is equipped with a trolley system having a battery in the power house. On this road the car descending the grade delivers back to the battery over the line about 33 per cent. of the energy which it consumes in ascending, so that it is beyond question that these applications should be taken advantage of wherever it is possible, the economy being so apparent.

The cars that have been in operation on the Paris roads for three years are of the old type, with the batteries placed under the seats, but new cars are being equipped with one box of batteries suspended under the car, thus eliminating the many disagreeable features incident to locating the batteries under the seats. The practice heretofore has been to run 33 miles on one charge with a battery weighing about three tons. With the newer cars the battery weighs about one and a half tons and runs one 11 mile trip on a charge, although under good conditions it would be capable of two such trips. In the new cars no mechanical brake is used at all, the braking being accomplished by the charging of the battery, although for the final stop the motor armatures are short circuited. The motors are shunt wound, always used in multiple, and in starting resistance is inserted in the armature circuits, which is gradually removed to increase the speed until it is all out. To attain full speed, the field is weakened by inserting resistance.

The matter of charging the batteries on this road has received very careful attention, and has been modified at various times. Originally, when the road was started, the battery was charged at a constant potential, 108 cells being thrown on to a 200 volt bus. Under these conditions the charging current commenced about 150 amperes, but gradually decreased so that at the end of charge it has reached about 10 amperes. They now use two buses. The battery is thrown on to a bus equivalent to 2·4 volts per cell, where it is left for three hours, or until the current has fallen from 90 to about 30 amperes. At the end of the third hour the battery is thrown on a higher bus, equivalent to 2·55 volts per cell, on which the charge is completed in from one to two hours, or more, thus avoiding the use of resistance.

The most interesting feature in connection with the operation of this road is the method of repasting the positive plates. The positive support plate is grooved and made of an alloy, upon which there is very little electrolytic action, and by a special process the peroxide which has been deposited on the bottom of the jars in a worn out cell is repasted into these grooves. Two men are employed repasting and are able to keep some thirty cars in continuous service, so that the cost of this portion of the operation is wonderfully small. I saw a number of these grids which had run between 25,000 and 50,000 miles, showing no evidence whatever of depreciation. The casting of these grids is carried on by a special process, by which the alloy is cast under very heavy air pressure, which method is protected by an original American patent, the French patents of which have been assigned to the French Chloride Company.

The Sector Clichy, a five wire station at Paris, has two very large batteries, installed last fall, one-half being manufactured by the Chloride Company, and the other half by the Tudor Company. This battery, which is now complete, is probably one of the largest in the world.

In Germany, the Tudor Company, with works at Hagen, have during the past eight years installed over 5,000 plants.

A most interesting application of storage battery has just been made by them on the street railroad of Hanover, where the cars are propelled by storage batteries within the city limits, and run by the trolley outside, the battery being charged without removal while the cars are running through the outskirts. Forty-four cars have been installed on this plan. Battery cars are also running in Berlin, Hagen and other German cities, and also in Vienna. Up to the past year the German Tudor Company has devoted its attention almost entirely to lighting work, but in Germany and France there is a feeling that the time is ripe for the development of storage battery traction, and within the next year a great deal will be accomplished in this line.

It is well known that in this country patent litigation has long interfered with the development of the storage battery business. Something over a year ago one strong company acquired all the patent rights of the contending companies, thus removing all question on the score of patents. This company being also allied with the three strongest European companies, is able to take advantage of every improvement that is made either here or abroad, and can therefore produce the best battery obtainable.

Some months ago the New York & Harlem River Railroad Company, of New York, decided to place two storage battery cars on its Madison Avenue line, to be operated through the winter, in order to determine whether or not the system has been brought to a stage of advancement which would warrant the equipment of the entire road.

In the cars run from Eighty-fifth Street to One Hundred and Thirty-fifth Street the batteries are suspended between the axles on the car truck, entirely independent of the car body. In fact, so independent are the trucks that they have been run alone without any car body on them at all. The cars have standard Stephenson bodies 10 ft. long and standard Peckham trucks.

Sixty cells of nine plate traction type chloride accumulators, capacity 400 ampere hours, are placed in a tray about 4½ ft. square and connected up solidly by lead burning, in two series, of thirty cells each. This tray is placed on a small transfer truck, running on a narrow gage track in a pit 8 ft. below the level of the street car tracks. An electric elevator is utilized to hoist the tray full of batteries, together with transfer truck, up between the street car rails into position on the street car truck, where the tray is automatically locked and the elevator, with transfer car, withdrawn. Large contact shoes on the car, kept in place by steel springs, engage with contact-plates on the trays, as batteries are raised, so that the connections are made automatically.

Each car is equipped with two G. E. 800 motors, supported outside of the axles, and two "K" controllers. A cable system will be applied to the shifting of the transfer cars in the battery pit.

The special advantages of this particular method of battery application include the features before mentioned, of low steps for cars and the standard height and width of seats; an entire independence of car body permitting of a change, as, for instance, from open to closed car bodies, and vice versa; together with an entire absence in the car of odor from the battery electrolyte; a compact, easily handled tray of batteries; utilization of space below and above the street car floor, without occupying one square foot of the car shed proper.

In the past, batteries were made of a practically uniform type of small size, capacity being obtained by putting many series of cells in multiple. Now large units in batteries have come into use, just as large generating units have, an example of this being the battery installed in the Boston Edison Company's station, where each cell weighs about three tons, capacity 8,000 A. H., or 16,000 A. H. at 140 volts, with a maximum output of 8,000 amperes.

The size of cell should be increased almost indefinitely. Batteries are now constructed specially to suit the work for which they are intended. Until recently in isolated plants, such as private houses, 150 ampere hour cells in glass jars were generally used, as many as eight of such series being installed in one house. A private house plant has been recently installed in this city, with one series of cells of 2,500 ampere hours each, and in the last three months half a dozen similar plants have been installed, varying in size from 1,000 ampere hours up.

Within the last year the question of electric train lighting has come up with considerable force, and cars are now running between New York and Chicago lighted by storage batteries alone, without any systems for operating dynamos and engines on the train. Train lighting in this country is a different matter from train lighting in Europe. In Europe a few 8 candle power lamps to the car are considered sufficient. The cars just referred to as running between New York and Chicago have 44 16 candle power lamps. A train consisting of five or six such cars requires a lighting plant of quite serious proportions.

Experiments are being made with more or less success with small dynamos driven from the axle of the car; a moderate sized storage battery is used to maintain the lights when the speed of the train falls below some 20 miles an hour. A car so lighted is now running satisfactorily between New York and Washington.

Perhaps the application of storage batteries which will arouse greatest interest is that of stationary batteries applied to equalizing the load on trolley lines. Two or three plants of this character have been installed within the past year. In a road of considerable length, the application of a storage battery would save in feeder copper a great deal more than its own first cost, and the contingent advantages to be derived from the operating of the generating plant at a practically constant load are too well known to require reiteration.

The application of batteries to electric elevator installations shows as great or even greater advantages. As Mr. Sprague stated in his paper before the last meeting of the American Institute of Electrical Engineers, to operate six elevators without a battery would require a 120 kilowatt generating plant, while the average load would be but 35 to 40 per cent. of this.

With a properly constructed battery, he states that the direct plant could be reduced to 60 kilowatts, or even to 50. A battery was installed last fall in connection with the elevator plant in the new court house at Minneapolis, and the curves shown prove the effect. A similar plant is just being installed in the Chicago Board of Trade building for the same purpose.

In this class of work, it is necessary that the battery should be capable of discharging at rates which would completely exhaust it in from half an hour to an hour. These discharges, of course, are not long continued, and the batteries as now constructed are not injured by this treatment. Up to two or three years ago a 10 hour rate of discharge was considered a maximum rate. Recent improvements in the manufacture of storage batteries have been entirely along the line of producing a battery which is capable of discharging in from one to three hours, although the cost has not materially decreased, if capacity alone is considered; but when discharge rate is considered, the cost has been greatly reduced, since a battery which can be discharged at five times its normal rate will replace one five times its size of the old type.

One feature of the battery business which has received a good deal of attention recently is the specific gravity of the electrolyte. The curves shown are very interesting, as they show how the capacity of a cell varies with the density of the electrolyte; the plates being respectively ¼ inch thick and 4-10 inch thick. The thicker plate has a maximum capacity when the density of the acid is about 1·275; the ¼ inch plate has a maximum capacity when the electrolyte is about 1·240. It is very noticeable how rapidly the capacity falls off on either side the maximum point. These curves are taken from two chloride cells, the volume of the electrolyte being sufficient to prevent any great change in specific gravity. The mean volts on discharge shown in the upper curves rise almost regularly as the acid density rises.

The rate of discharge being the same per pound of active material, the discharge rate per superficial area is therefore approximately 40 per cent. greater with the thick plate than with the thin.

The battery just being installed in the new Edison Station at Twelfth Street, New York, consists of 150 4,000 ampere hour cells. The positive plates of this battery somewhat resemble the "Tudor" type, the negatives are the "chloride" type. They are installed 75 cells on each side of the three wire system; the 25 end cells on each side are used as regulating cells, being connected by copper bar to four regulating switches, two on each side, so that the battery can be discharged at different potentials. The battery has a capacity at 10 hour rate of 4,000 ampere hours on each side, at a 3 hour rate of 3,000 ampere hours on each side, and at one hour rate of 2,000 ampere hours on each side.

The erection of the battery in two tiers, the upper tier of iron framework, is perhaps new in this country. The insulation of the cells is effected by a special type of oil insulator, which makes this method of erection quite safe. The battery is installed in a room approximately 20 feet by 40 feet, which is, I think, the smallest space in which a battery of equal capacity has yet been placed.

Another Edison station recently equipped is in Lawrence, Mass., where a smaller battery, with capacity of about 1,500 ampere hours, is in use; this battery is discharged completely in two hours between four and six in the afternoon, during the peak of the load.

The motocycle contest in Chicago has attracted a good deal of attention to the question of electric road wagons. The carriage which secured the gold medal, first prize, was built by Caffrey, of Philadelphia, and weighed complete 1,650 pounds, including a battery weighing 664 pounds. The battery consisted of 44 50 ampere hour chloride cells; the wagon was equipped with two 1½ horse power Lundell motors, with series parallel controller.

This carriage is capable of running from 25 to 30 miles on one charge at a speed of 10 miles an hour; it could attain a maximum speed of about 20 miles an hour for one hour, carrying four people. The two front wheels of the carriage are driving wheels and it is steered by the rear wheels. On the first speed with an average discharge of 5·6 amperes, or two-thirds of an electrical horse power, a speed of 4·6 miles was attained, and at this speed the carriage would travel 46 miles on one charge. On the second speed, running at 10 miles an hour, it required 13·2 amperes or 1 56-100 horse power, covering by this speed about 30 miles on one charge.

This carriage has been sold and shipped to Germany

* Read before the New York Electrical Society, January 29, 1896.

to be used as a model for building similar ones over there.

This question of electric vehicles is attracting the attention of the large carriage and bicycle manufacturers, many of whom are building such vehicles, and with a battery such as is now produced capable of very heavy discharges, and with good roads, it would appear as though the business would soon assume large proportions.

The use of electric launches is growing steadily, but not as rapidly as other applications. In this work light weight is not so important as for carriage work, but batteries for this work must have large capacity, as it is often necessary to make long runs before facilities for recharging can be obtained.

The improvement in storage cells for this work is shown in the fact that the batteries on the launches which ran for three months at the Atlanta Exposition did not cost one cent for repairs, which was not the case with those used at Chicago, at the World's Fair. The battery used at Atlanta was the chloride type.—Electrical Engineer.

THE COMPOSITION OF EXPIRED AIR AND ITS EFFECTS UPON ANIMAL LIFE.

A MEMOIR bearing the above title has been recently issued in the series of Smithsonian Contributions to Knowledge, No. 989, by J. S. Billings, M.D., S. Weir Mitchell, M.D., and D. H. Bergey, M.D. It gives the result of investigations carried on under a grant from the Hodgkins Fund of the Smithsonian Institution, for the purposes of determining the nature of the peculiar substances of organic origin contained in the air expired by human beings, with special reference to the practical application of the results obtained to problems of ventilation of inhabited rooms. The conclusions contain so much of general interest that they are printed here in full.

1. The results obtained in this research indicate that in air expired by healthy mice, sparrows, rabbits, guinea pigs, or men, there is no peculiar organic matter which is poisonous to the animals mentioned (excluding man), or which tends to produce in these animals any special form of disease. The injurious effects of such air observed appeared to be due entirely to the diminution of oxygen, or the increase of carbonic acid, or to a combination of these two factors. They also make it very improbable that the minute quantity of organic matter contained in the air expired from human lungs has any deleterious influence upon men who inhale it in ordinary rooms, and hence it is probably unnecessary to take this factor into account in providing for the ventilation of such rooms.

2. In ordinary quiet respiration, no bacteria, epithelial scales, or particles of dead tissue are contained in the expired air. In the act of coughing or sneezing, such organisms or particles may probably be thrown out.

3. The minute quantity of ammonia, or of combined nitrogen, or other oxidizable matters found in the condensed moisture of human breath, appears to be largely due to products of the decomposition of organic matter which is constantly going on in the mouth and pharynx. This is shown by the effects of cleansing the mouth and teeth upon the amount of such matters in the condensed moisture of the breath, and also by the differences in this respect between the air exhaled through a tracheal fistula and that expired in the usual way.

4. The air in an inhabited room, such as the hospital ward in which experiments were made, is contaminated from many sources besides the expired air of the occupants, and the most important of these contaminations are in the form of minute particles or dust. The experiments on the air of the hospital ward, and with the moisture condensed therefrom, show that the greater part of the ammonia in the air was probably connected with dust particles which could be removed by a filter. They also showed that in this dust there were micro-organisms, including some of the bacteria which produce inflammation and suppuration, and it is probable that these were the only really dangerous elements in this air.

5. The experiments in which animals were compelled to breathe air vitiated by the products of either their own respiration or by those of other animals; or were injected with fluid condensed from expired air, gave results contrary to those reported by Hammond, by Brown-Sequard and D'Arsonval, and by Merkel, but corresponding to those reported by Dastre and Loye, Russo-Giliberti and Alessi, Hoffmann-Wellenhof, Rauer and other experimenters referred to in the preliminary historical sketch of this report, and make it improbable that there is any peculiar volatile poisonous matter in the air expired by healthy men and animals, other than carbonic acid. It must be borne in mind, however, that the results of such experiments upon animals as are referred to in this report may be applicable only in part to human beings. It does not necessarily follow that a man would not be injured by continually living in an atmosphere containing two parts per 1,000 of carbonic acid and other products of respiration, of cutaneous excretion, and of putrefactive decomposition of organic matters, because it is found that a mouse, a guinea pig, or a rabbit seems to suffer no ill effects from living under such conditions for several days, weeks, or months; but it does follow that the evidence which has heretofore been supposed to demonstrate the evil effects of bad ventilation upon human health should be carefully scrutinized.

6. The effects of reduction of oxygen and increase of carbonic acid to a certain degree appear to be the same in artificial mixtures of these gases as in air in which the change of proportion of these gases has been produced by respiration.

7. The effect of habit, which may enable an animal to live in an atmosphere in which, by gradual change, the proportion of oxygen has become so low, and that of the carbonic acid so high, that a similar animal brought from fresh air into it dies almost immediately has been observed before, but we are not aware that a continuance of this immunity produced by it had been previously noted. The experiments reported in the Appendix, VII, 17 to 28, show that such an immunity may either exist normally or be produced in certain mice, but that these cases are very exceptional, and it is very desirable that a special research should be made to determine, if possible, the conditions upon which such a continuance of immunity depends.

8. An excessively high or low temperature has a decided effect upon the production of asphyxia by diminution of oxygen and increase of carbonic acid. At high temperatures the respiratory centers are affected, where evaporation from the skin and mucous surfaces is checked by the air being saturated with moisture; at low temperatures the consumption of oxygen increases, and the demand for it becomes more urgent.

So far as the acute effects of excessively foul air at high temperatures are concerned, such for example as appeared in the Black Hole at Calcutta, it is probable that they are due to substantially the same causes in man as in animals.

9. The proportion of increase of carbonic acid and diminution of oxygen which has been found to exist in badly ventilated churches, schools, theaters or barracks, is not sufficiently great to satisfactorily account for the great discomfort which such conditions produce in many persons, and there is no evidence to show that such an amount of change in the normal proportion of these gases has any influence upon the increase of disease and death rates which statistical evidence has shown to exist among persons living in crowded and unventilated rooms. The report of the commissioners appointed to inquire into the regulations affecting the sanitary conditions of the British army (1) properly lays great stress on the fact that in civilians at soldiers' ages, in twenty-four large towns, the death rate per 1,000 was 11·9, while in the foot guards it was 20·4, and in the infantry of the line 17·9, and showed that this difference was mainly due to diseases of the lungs occurring in soldiers in crowded and unventilated barracks. These observations have since been repeatedly confirmed by statistics derived from other armies, from prisons, and from the death rates of persons engaged in different occupations; and, in all cases, tubercular disease of the lungs and pneumonia are the diseases which are most prevalent among persons living and working in unventilated rooms, unless such persons are of the Jewish race. But consumption and pneumonia are caused by specific bacteria, which, for the most part, gain access to the air passages by adhering to particles of dust, which are inhaled, and it is probable that the greater liability to these diseases of persons living in crowded and unventilated rooms is, to a large extent, due to the special liability of such rooms to become infected with the germs of these diseases. It is, however, by no means demonstrated as yet that the only deleterious effect which the air of crowded barracks or tenement house rooms or of foul courts and narrow streets exerts upon the persons who breathe it, is due to the greater number of pathogenic micro-organisms in such localities. It is quite possible that such impure atmospheres may affect the vitality and the bacterioidal powers of the cells and fluids of the upper air passages with which they come in contact, and may thus predispose to infections, the potential causes of which are almost everywhere present, and especially in the upper air passages and in the alimentary canal of even the healthiest persons, but of this we have as yet no scientific evidence. It is very desirable that researches should be made on this point.

10. The discomfort produced by crowded, ill ventilated rooms in persons not accustomed to them, is not due to the excess of carbonic acid, nor to bacteria, nor in most cases, to dusts of any kind. The two great causes of such discomfort, though not the only ones, are excessive temperature and unpleasant odors. Such rooms as those referred to are generally overheated, the bodies of the occupants and, at night, the usual means of illumination contributing to this result.

The cause of the unpleasant, musty odor which is perceptible to most persons on passing from the outer air into a crowded, unventilated room is unknown; it may, in part, be due to volatile products of decomposition contained in the expired air of persons having decayed teeth, foul mouths, or certain disorders of the digestive apparatus, and it is due, in part, to volatile fatty acids given off with or produced from the excretions of the skin and from clothing soiled with such excretions. It may produce nausea and other disagreeable sensations in specially susceptible persons, but most men soon become accustomed to it, and cease to notice it, as they will do with regard to the odor of a smoking car, or of a soap factory, after they have been for some time in the place. The direct and indirect effects of odors of various kinds upon the comfort, and perhaps also upon the health of men, are more considerable than would be indicated by any tests now known for determining the nature and quantity of the matters which give rise to them. The remarks of Renk (38, p. 174) upon this point merit consideration. Cases of fainting in crowded rooms usually occur in women, and are connected with defective respiratory action due to tight lacing or other causes.

Other causes of discomfort in rooms heated by furnaces or by steam are excessive dryness of the air, and the presence of small quantities of carbonic oxide, of illuminating gas, or of arsenic derived from the coal used for heating.

11. The results of this investigation, taken in connection with the results of other recent researches summarized in this report, indicate that some of the theories upon which modern systems of ventilation are based are either without foundation or doubtful, and that the problem of securing comfort and health in inhabited rooms requires the consideration of the best methods of preventing or disposing of dusts of various kinds, of properly regulating temperature and moisture, and of preventing the entrance of poisonous gases like carbonic oxide, derived from heating and lighting apparatus, rather than upon simply diluting the air to a certain standard of proportion of carbonic acid present.

It would be very unwise to conclude from the facts given in this report that the standards of air supply for the ventilation of inhabited rooms, which standards are now generally accepted by sanitarians as the result of the work of Pettenkofer, De Chaumont and others, are much too large under any circumstances, or that the differences in health and vigor between those who spend the greater part of their lives in the open air of the country hills and those who live in the city slums do not depend in any way upon the differences between the atmospheres of the two localities except as regards the number and character of micro-organisms.

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